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DRIFT-PLATTEVILLE AQUIFER

SOURCE AND GRADIENT CONTROL WELLS

CONSTRUCTION AND AQUIFER TEST REPORT

ERT
A RESOURCE ENGINEERING COMPANY

DRIFT-PLATTEVILLE AQUIFER

SOURCE AND GRADIENT CONTROL WELLS

CONSTRUCTION AND AQUIFER TEST REPORT

Submitted to

U.S. Environmental Protection Agency, Region V
and
Minnesota Pollution Control Agency

Submitted by

Reilly Tar & Chemical Corporation
Indianapolis, Indiana

Pursuant to
Remedial Action Plan Section Numbers 9.1.2 and 9.2.2
Exhibit A to the Consent Decree in
United States of America, et al. v. Reilly Tar & Chemical Corp., et al.
U.S. District Court, District of Minnesota, Civil No. 4-80-469

December 9, 1987

INTRODUCTION

Construction and testing have been completed for the Drift-Platteville Aquifer Source and Gradient Control Wells at the Reilly Tar & Chemical Corporation N.P.L. Site in St. Louis Park, Minnesota in accordance with Work Plans submitted by Reilly per the Consent Decree-Remedial Action Plan (RAP). This report presents the logs for three new well installations, the results of pumping tests performed at each new well, and field adjustments to the approved designs for each well. This document fulfills the reporting requirements of RAP Sections 9.1.2 and 9.2.2.

Approvals for the Drift Platteville Aquifer Source Control Well Work Plan and the Drift-Platteville Gradient Control Well Work Plan were received on July 9, 1987. The last permits required for construction were received on August 11, 1987; and, in accordance with RAP Sections 9.1.2 and 9.2.2, all construction, testing, and reporting have been completed within 120 days of that date (December 9, 1987). Construction included the installation of the three wells, construction of appropriate well houses, and connections to the sanitary sewers. Pumping tests included monitoring water levels in the Drift-Platteville Aquifer in numerous observation wells during periods of stressed and non-stressed aquifer conditions.

WELL CONSTRUCTION

The Drift-Platteville Aquifer Source and Gradient Control Wells were drilled and installed in accordance with the approved, amended Work Plans. There were no field adjustments to the approved designs of each well. Bergerson-Caswell, Inc. constructed each well under the direction of ERT, Inc. The Water Well Record for each well is presented in Appendix A, along with the pilot soil boring logs and grain size analyses. As indicated on the Water Well Records, direct rotary techniques were used to advance a nominal 10-inch diameter hole through the drift. Six-inch well screen and/or pipe was then set in the hole and grouted into place. A graded sand pack was placed around the screens in the two Drift Aquifer wells. The Platteville Aquifer well was completed by drilling a nominal six-inch diameter hole through the full thickness of the Platteville Limestone.

Upon completion of the wells, each well was developed. The Drift Aquifer Source Control Well was developed for approximately 32 hours, using a combination of air-lifting and high-velocity jetting. This well responded nicely to the development by producing a sediment-

free discharge with an approximate specific yield of 10 gpm per foot of drawdown during development.

The Platteville Aquifer Source Control Well was developed by air-lifting. A sediment free discharge was obtained after four hours with an approximately specific yield of only two gpm per foot of drawdown.

The Drift-Platteville Aquifer Gradient control Well was developed by airlifting and high-velocity jetting. A total of 42 hours was spent developing this well. The well was slow to respond to development, although there were no fine grained silts or clays encountered in the pilot soil boring or the well itself that could have accounted for the slow development. At the end of development the well was producing a sediment-free discharge with an approximate specific capacity of 7 gpm per foot of drawdown.

The measuring point elevants for each well were surveyed following completion of each well, with the following results:

Drift Aquifer Source control Well:	895.83 Feet MSL
Platteville Aquifer Source Control Well:	895.79 Feet MSL
Drift-Platteville Aquifer Gradient Control Well:	908.18 Feet MSL

DRIFT AQUIFER SOURCE CONTROL WELL AQUIFER TEST

The Drift Aquifer Source Control Well aquifer test was the first of three aquifer tests performed. In preparation for the three tests, potential observation wells in the area were located and examined. Wells that were not sealed, damaged, or destroyed were subjected to a brief slug test to demonstrate the well's response to hydraulic stress. The following wells recovered to 90 percent of their original water level after the removal of one well volume of water, and were considered for use as observation wells during the aquifer tests:

P8	P124	W20
P11	P201	W22
P14	P203	W26
P15	W2	W100
P69	W5	W143
P109	W9	W-1*
P110	W11	W-2*
P112	W17	NL-1*
P121	W18	MW-1*
P123	W19	MW-2*

* These are monitoring wells at the National Lead/Taracorp site.

The following wells were not considered for use as observation wells during the aquifer tests because the were either damaged or they did not respond sufficiently during slug tests: W27, W13, W12, W132, P9, P45, P65, P25, P118, and P122.

The observation wells selected for use during the Drift Aquifer Source Control Well aquifer test were wells W2, W5, W9, W11, W18, P14, P15, P124, P203, Taracorp wells MW-1 and MW-2, and the Platteville Aquifer Source Control Well. This array of wells is shown in Figure 1, and includes at least one Drift Aquifer observation well within 200 feet, and one Drift Aquifer observation well within 1000 feet, of the pumping well, as indicated in the Work Plan. Well W2 was used to identify extraneous influences (e.g., water level changes due to precipitation) because it is beyond the cone of influence of the pumping well.

In-Situ, Inc. Hermit data loggers were used to record water level data for wells W2 and W5 for this test, and an In-Situ, Inc. SE-200 system was used for the other 11 wells. Water levels were recorded for 48 hours prior to the pumping phase of the aquifer test. The Drift Aquifer Source Control Well was pumped at 200 gallons per minute commencing on September 17, 1987 at 7:47 p.m., and ending on September 20, 1987 at 10:37 p.m. (approximately 75 hours). Water levels were then measured for 48 hours during which time the levels recovered to pre-test conditions. Data was lost from Taracorp well MW-2 during the pumping phase of the aquifer test due to an interruption in the transducer circuit.

Many of the observation wells exhibited water level fluctuations in response to the aquifer test. Five of the eight observation wells in the Drift formation produced data amenable to analysis (P14, P15, W9, P124, P203). The data from these wells were analyzed using the Prickett method for analysis of pumping test data from an unconfined aquifer (Prickett, 1965). The main assumptions inherent in the Prickett method are as follows:

1) aquifer is homogeneous, isotropic, of uniform thickness and has infinite areal extent,

2) pumping well fully penetrates unconfined aquifer, implying horizontal flow,

3) flow to the pumping well is not steady state and

4) well storage is neglected.

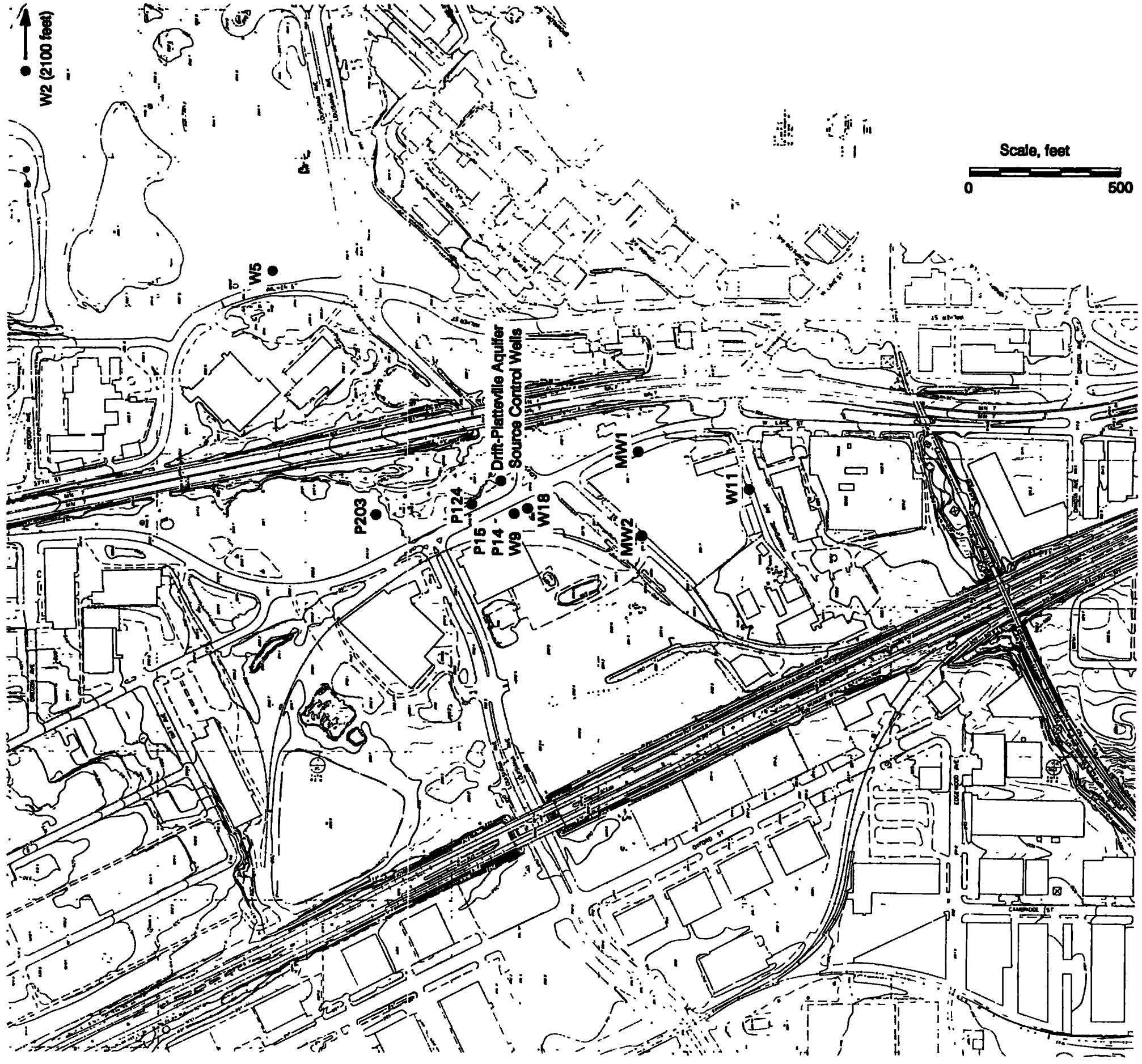

Figure 1. Location of Wells for the Drift Aquifer Source Control Well Aquifer Test

Hantush (1964) suggests that if the pumping well is only partially penetrating, drawdown in wells within 1.5 times the thickness of the aquifer may need to be corrected because the assumption of primarily horizontal flow could be violated. The correction is:

$$s' = s - s^2/2d$$

where:
s is the original drawdown
d is the thickness of the aquifer and
s' is the corrected drawdown.

For the first pump test, wells P14, P15 and W9 are within 1.5 times d, assuming d = 60 feet and the radial distance for each of the wells is 75 feet. The maximum drawdown in these three wells was 1.8 feet, producing a corrected drawdown of 1.77 feet. Because the maximum correction is so small, the analyses were done without correcting for partial penetration.

The data and the matchpoints used in the analyses for two representative wells (P15 and P124) are shown in Figures 2 and 3. The values calculated for the transmissivity for the first pump test range from 6.2e+4 gpd/ft to 1.7e+5 gpd/ft (Table 1), with a mean value of 1.0e+5 gpd/ft. These values are similar to these reported in the literature (CDM, 1985; Stark and Hult, 1984; Hult and Schoenburg, 1984; Hickok, 1981; and Barr, 1977). The values calculated for storativity range from 2.5e-2 to 4.5e-1 (Table 1), with a mean value of 1.4e-1. These are typical values for an unconfined aquifer.

The prepumping data for each of the wells analyzed do not show any appreciable trends, although the transducer in well W9 did show some instability with time, both in the background data and the pump test data. For this reason, only the early time data from well W9 were analyzed. The background well data (W2) did not show any appreciable changes over the duration of the first pump test (Figure 4) and were not corrected for in the analyses.

The barometric pressure data and precipitation data (collected from the Minneapolis-St. Paul Airport) over the duration of the three pump tests is presented in Figure 5. The background well data for all three pump tests do not show any response to the variations in these parameters and therefore the pump test data were not corrected for the effects of precipitation or variations in barometric pressure.

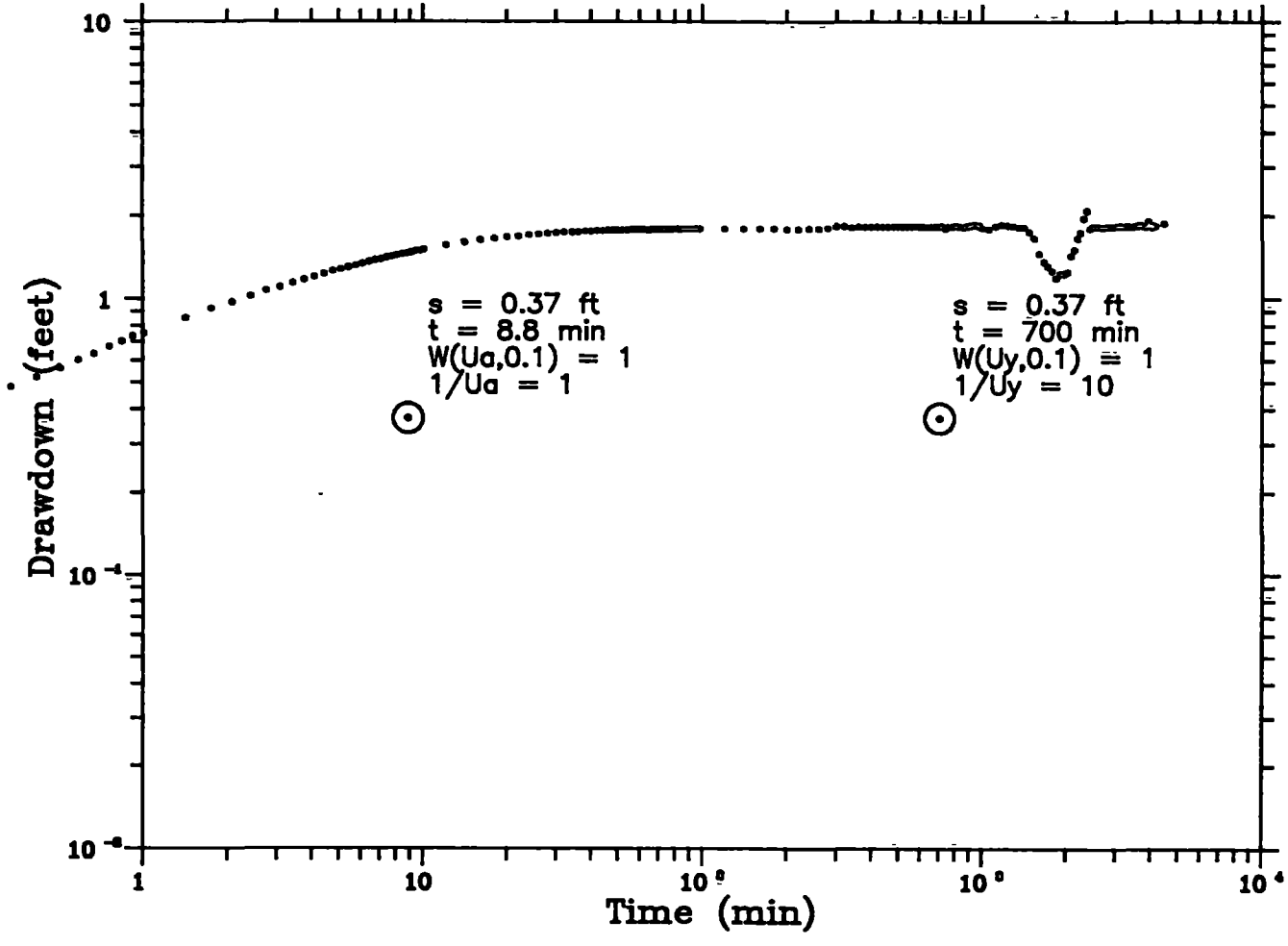

Figure 2. Drift Aquifer Source Control Well Aquifer Test

Drawdown Curve for Observation Well P15

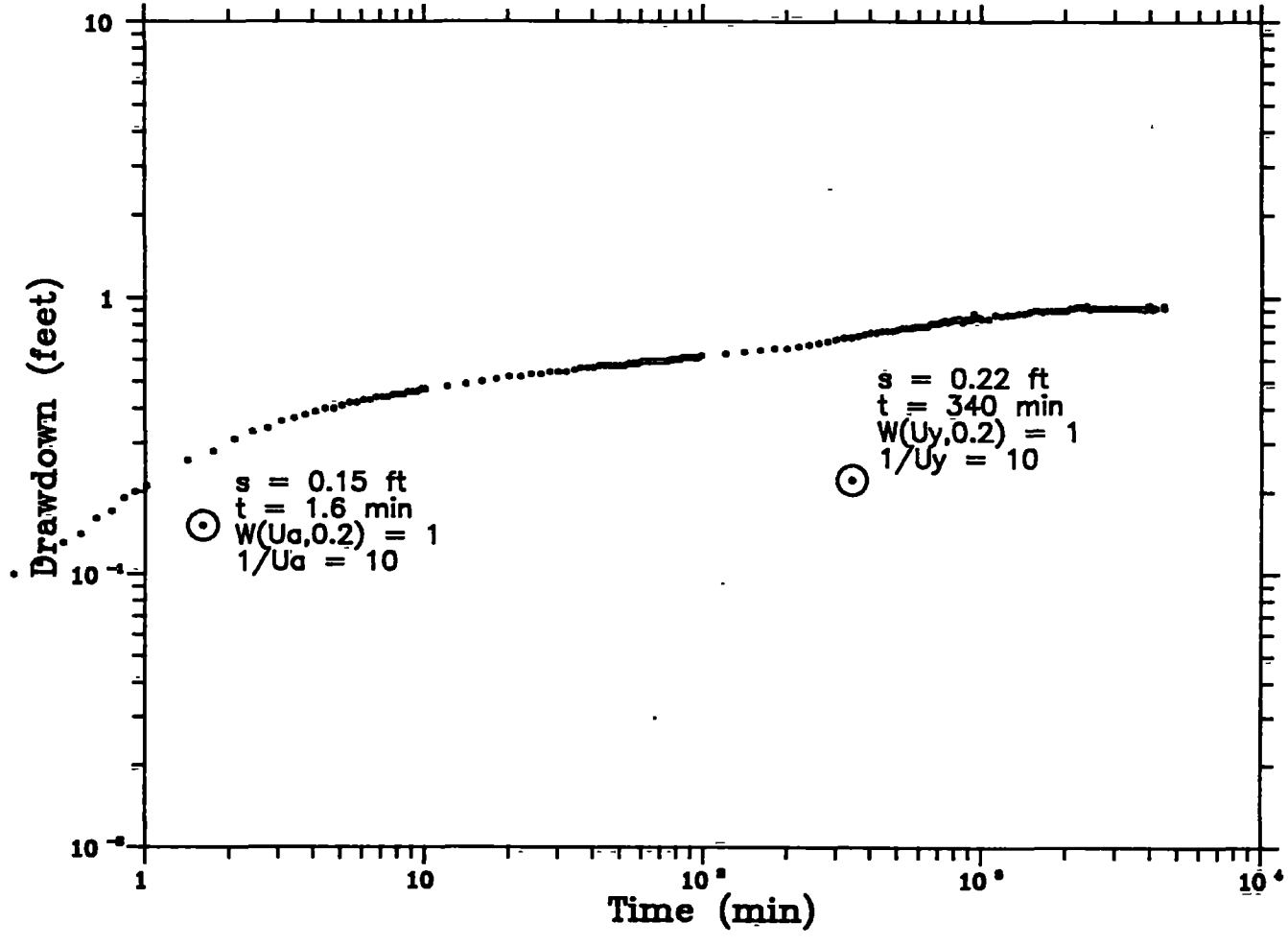

Figure 3. Drift Aquifer Source Control Well Aquifer Test,

Drawdown Curve for Observation Well P124

TABLE 1

TRANSMISSIVITY VALUES FROM THE

DRIFT AQUIFER SOURCE CONTROL WELL AQUIFER TEST

WELL NO.	TRANSMISSIVITY (GPD/FT)	STORATIVITY
P14	7.7×10^{4}	1.47×10^{-1}
P15	6.2×10^{4}	2.86×10^{-1}
W9	7.2×10^{4}	3.83×10^{-2}
P124	1.3×10^{5}	2.51×10^{-2}
P203	1.7×10^{5}	1.9×10^{-1}

Average T = 1.0×10^{5} gpd/ft

Average S = 1.37×10^{-1}

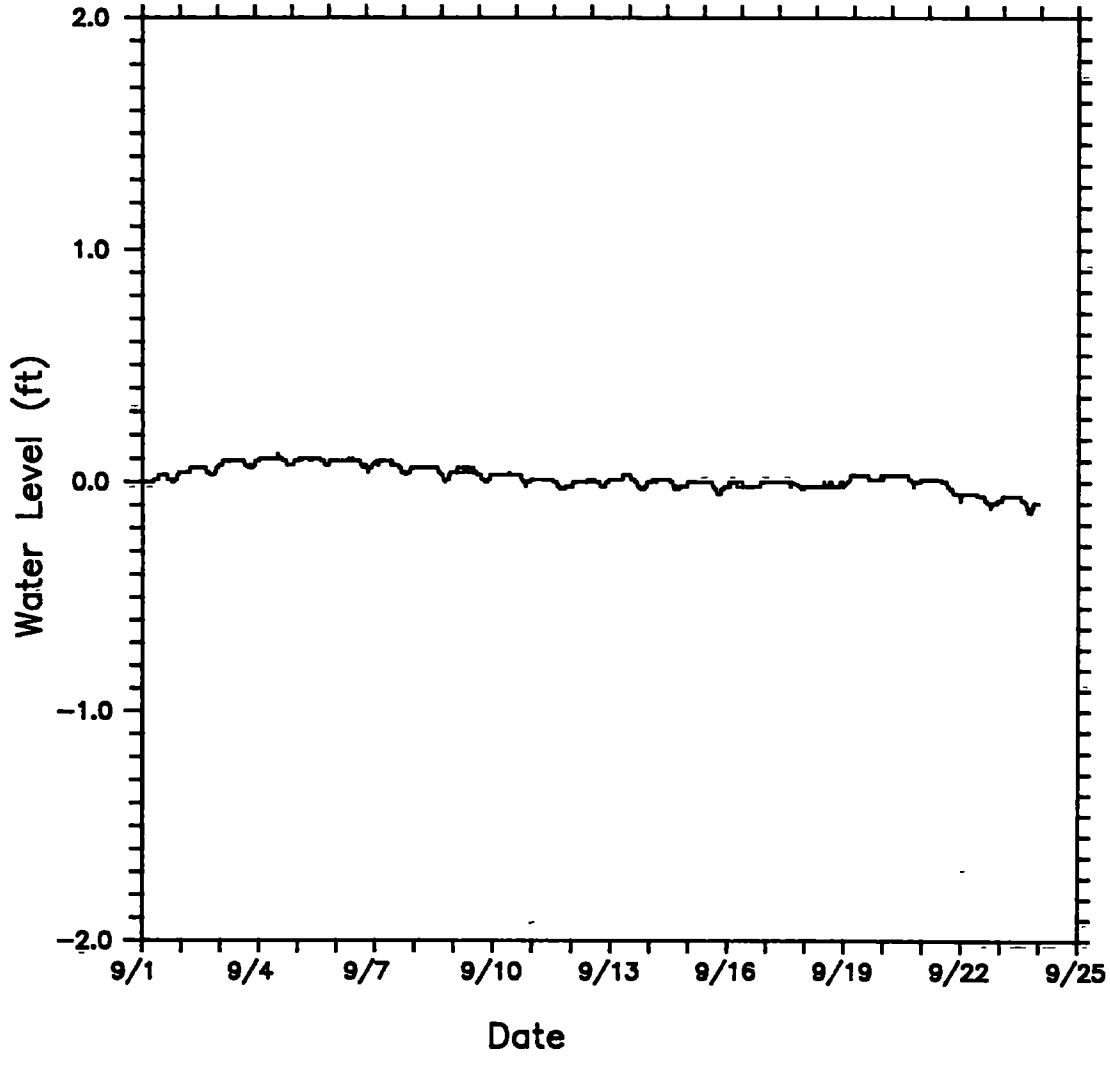

Figure 4: Drift Aquifer Source Control Well Aquifer Test, Background Water Level Data - Observation Well W2

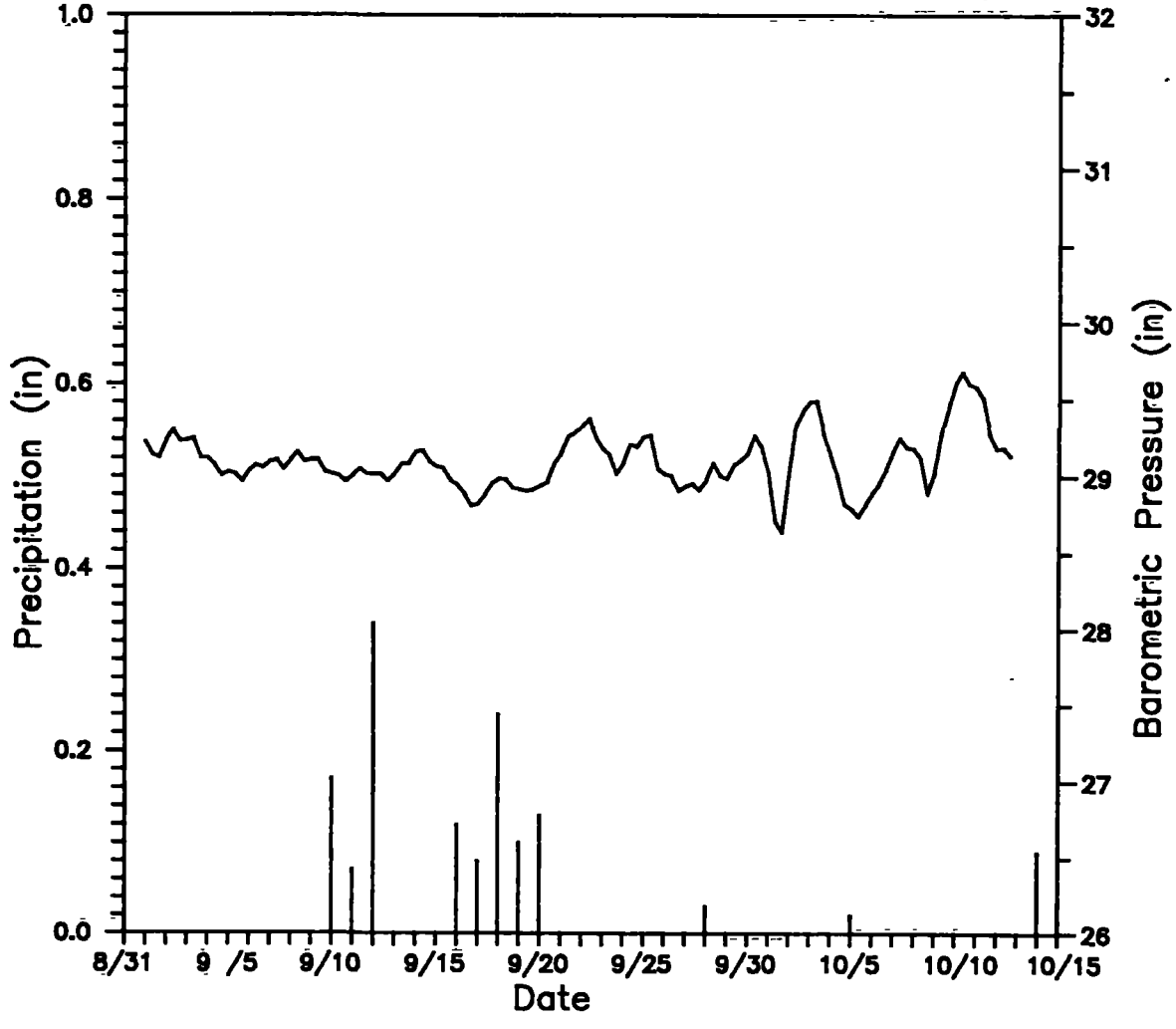

Figure 5. Precipitation and Barometric Data

PLATTEVILLE AQUIFER SOURCE CONTROL WELL AQUIFER TEST

The observation well selected for use during the Platteville Aquifer Source Control Well aquifer test were wells W18, W19, W20, W22, W26, W100, P14, P15, P121, P124, P203, Taracorp well MW-1, and the Drift Aquifer Source Control Well. These wells are shown in Figure 6. As indicated in the Work Plan, the array of observation wells for this aquifer test includes at least one Platteville Aquifer observation well within 300 feet, and one Platteville Aquifer observation well at about 1000 feet, from the pumping well. Well W100 was used to identify extraneous influences (e.g., water level changes due to precipitation) because it is beyond the cone of influence of the pumping well.

In-Situ, Inc. Hermit data loggers were used to record water levels in wells W100 and W20, and an In-Situ, Inc. SE-200 system was used for the other dozen wells. Water levels were recorded for 48 hours prior to the pumping phase of the aquifer test. The Platteville Aquifer Source Control Well was pumped at 55 gallons per minute commencing on September 26, 1987 at 10:08 p.m., and ending on September 27, 1987 at 10:20 p.m. (approximately 24 hours). Higher pumping rates caused too much drawdown in the well. Water levels were then measured for 41 hours during which time the levels recovered to pre-test conditions. Data was lost from Well W-22 during the recovery phase of the aquifer test due to an interruption in the transducer circuit.

Many of the observation wells exhibited water level fluctuations in response to the aquifer test. Five of the six Platteville observation wells produced data amenable to analysis (W18, W19, W22, W26, P121). Because the Platteville has been shown to be hydraulically linked with the Drift (Hult and Schoenburg, 1984), the data from the second pump test were analyzed using the Walton method for semi-confined aquifers (Walton, 1962). The main assumptions inherent to the method are as follows:

1) aquifer is homogeneous, isotropic, of uniform thickness and infinite areal extent,

2) pumping well fully penetrates the semi-confined aquifer,

3) overlying the aquitard is an unconfined aquifer,

4) water removed from storage is discharged instantaneously with decline of head and,

5) well storage is neglected.

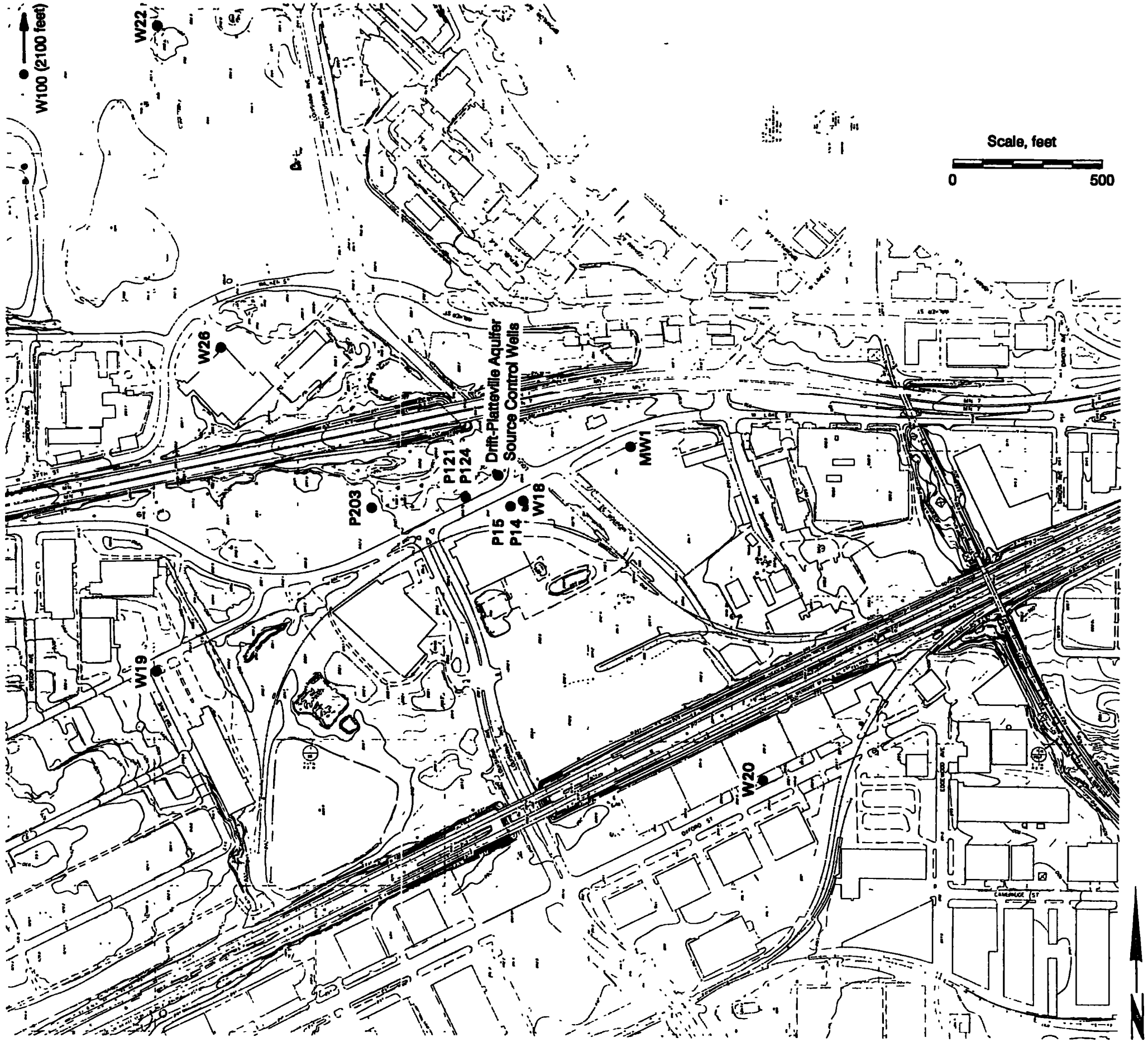

Figure 6. Location of Wells for the Platteville Aquifer Source Control Well Aquifer Test

The data matchpoints used in the analyses are shown in Figures 7 and 8 for two representative wells (W18, W19). The values calculated for transmissivity for the second pump test range from 2.0e+4 gpd/ft to 4.4e+4 gpd/ft (Table 2), with a mean transmissivity of 2.8e gpd/ft. These values fall within the range reported in the literature of 2.32e+4 (Hult, 1981) to 6.7e+4 gpd/ft (Stark and Hult, 1984) for the Platteville.

The prepumping data for each of the wells analyzed did not show any appreciable trends. However, the transducers in wells P121 and W26 both exhibited instabilities with increasing time. For this reason, only the early time data from these wells were used in the analyses.

The background well data (W100) did not show any appreciable changes over the period of the second pump test (Figure 9) and were not corrected for in the analyses.

The results from the first two pump tests suggest that the Platteville and Drift aquifers are hydraulically connected. During the Drift source control pump test, several of the observation wells screened in the Platteville showed noticeable drawdown, and wells P14 (Drift) and W18 (Platteville) exhibited responses that are typical of mutually leaky aquifers (Hantush, 1967). During the Platteville source control pump test, the response of the observation wells in the Platteville was typical of a semi-confined aquifer. The observation wells in the Drift did not show as great a response to the pumping of the Platteville, but this is partially due to the difference in pumping rates during the first two tests.

DRIFT-PLATTEVILLE GRADIENT CONTROL WELL AQUIFER TEST

The observation wells selected for use during the Drift-Platteville Aquifer Gradient Control Well aquifer test were wells W2, W11, W17, W143, P109, P110, P112, Taracorp wells W-1, W-2, MW-1, MW-2, and NL2. This array of wells is shown in Figure 10, and it includes at least one Drift Aquifer observation well within 600 feet, and at least one Drift Aquifer observation well within 1000 feet, of the pumping well as required by the Work Plan. Well W2 was used to identify extraneous influences (e.g., water level changes due to precipitation) because it is beyond the cone of influence of the pumping well.

In-Situ, Inc. Hermit data loggers were used to record water levels at wells P109, P110, and P112. The background well (W2) was monitored manually using an electric water level tape throughout the aquifer test. An In-Situ, Inc. SE-200 system was used to monitor water

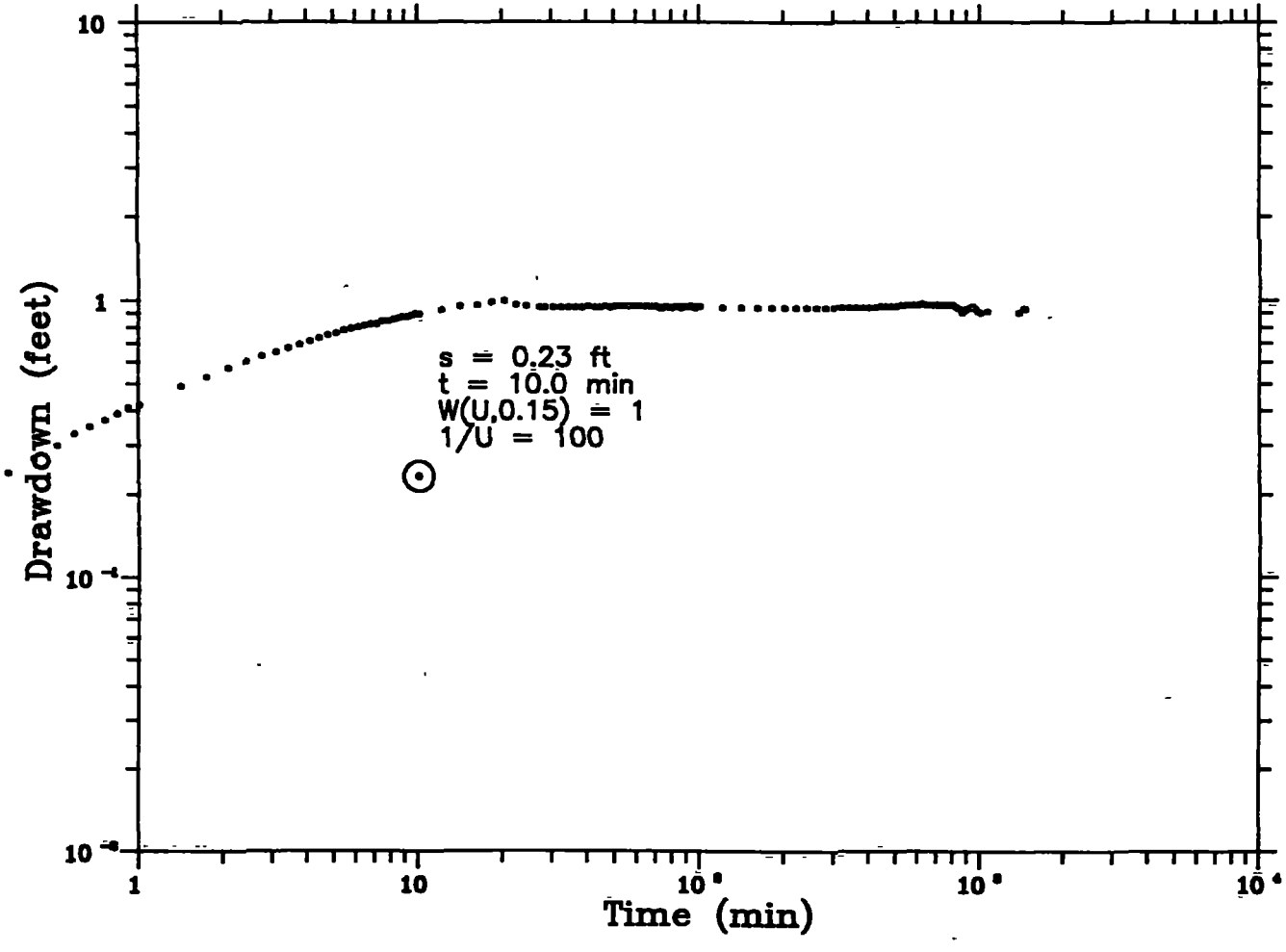

Figure 7. Platteville Aquifer Source Control Well Aquifer Test,

Drawdown Curve for Observation Well W18

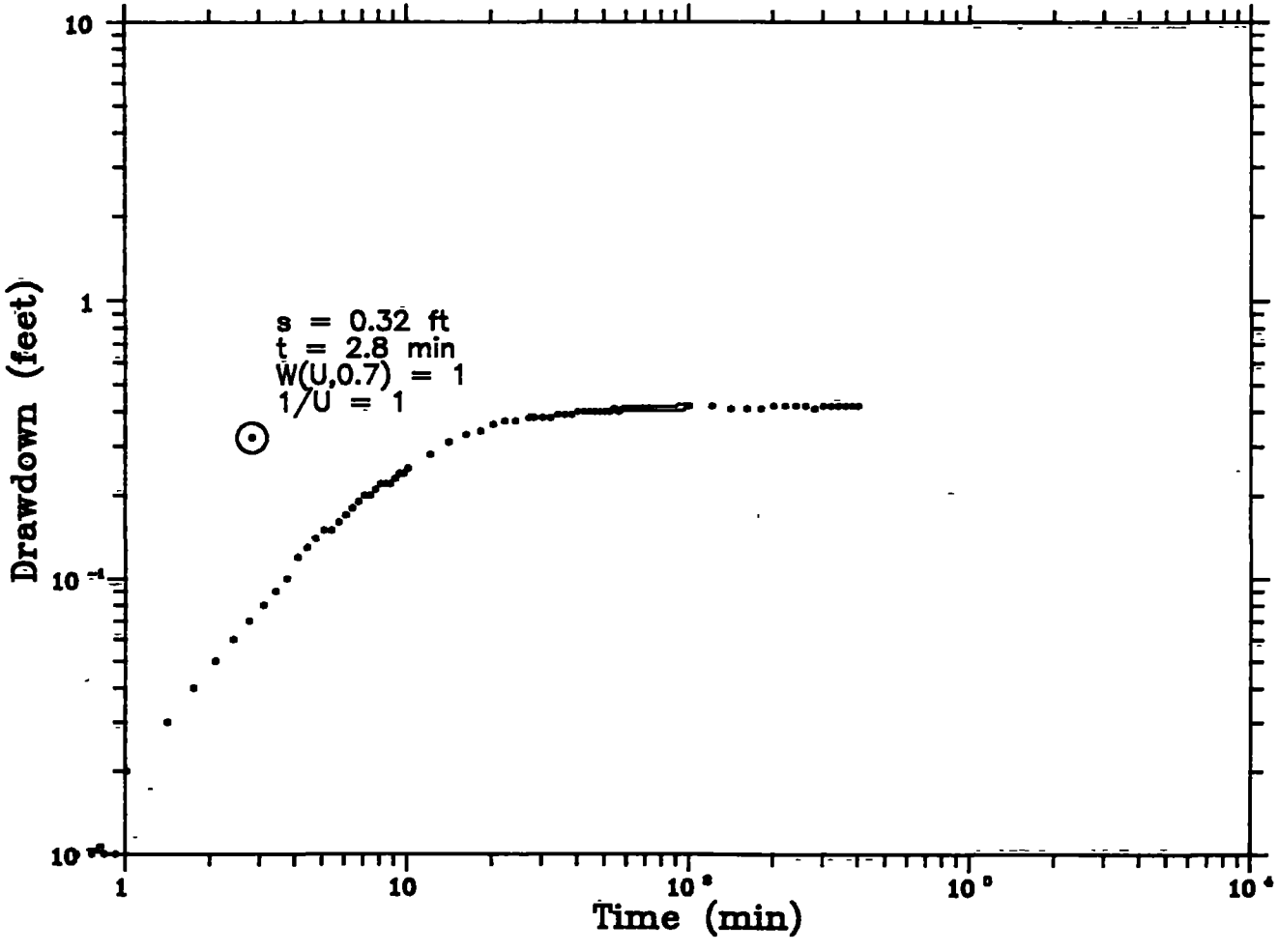

Figure 8. Platteville Aquifer Source Control Well Aquifer Test,

Drawdown Curve for Observation Well W19

TABLE 2

TRANSMISSIVITY VALUES FOR THE

PLATTEVILLE AQUIFER SOURCE CONTROL WELL AQUIFER TEST

WELL NO.	TRANSMISSIVITY (GPD/FT)	STORATIVITY
W19	2.0×10^{4}	1.08×10^{-5}
W22	4.4×10^{4}	4.89×10^{-5}
W18	2.8×10^{4}	1.87×10^{-4}
P121	2.5×10^{4}	1.8×10^{-5}
W26	2.4×10^{4}	8.8×10^{-5}

Average T = 2.8×10^{4} gpd/ft

Average S = 7.05×10^{-5}

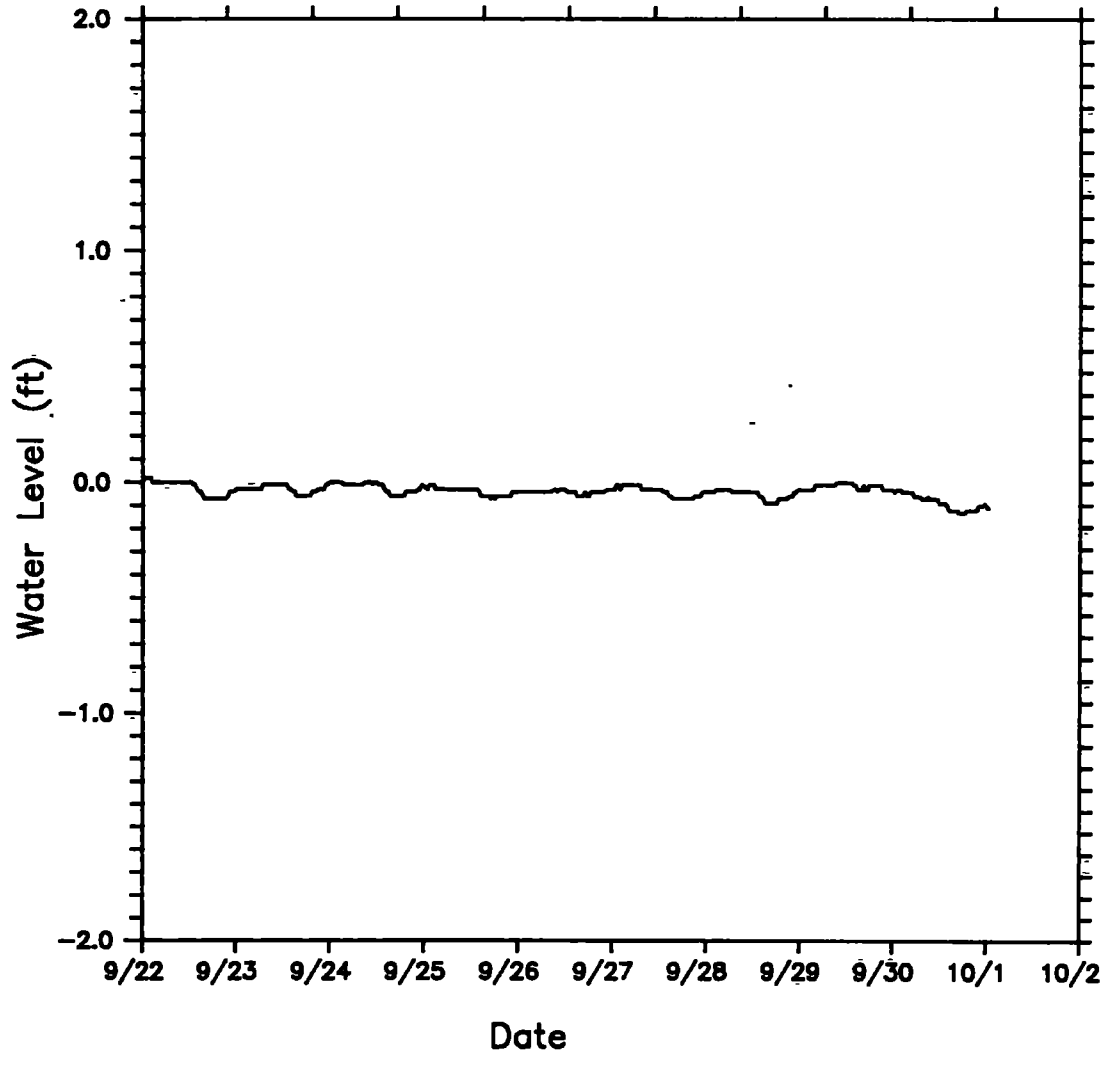

Figure 9. Platteville Aquifer Source Control Well Aquifer Test,

Background Water Level Data - Observation Well W100

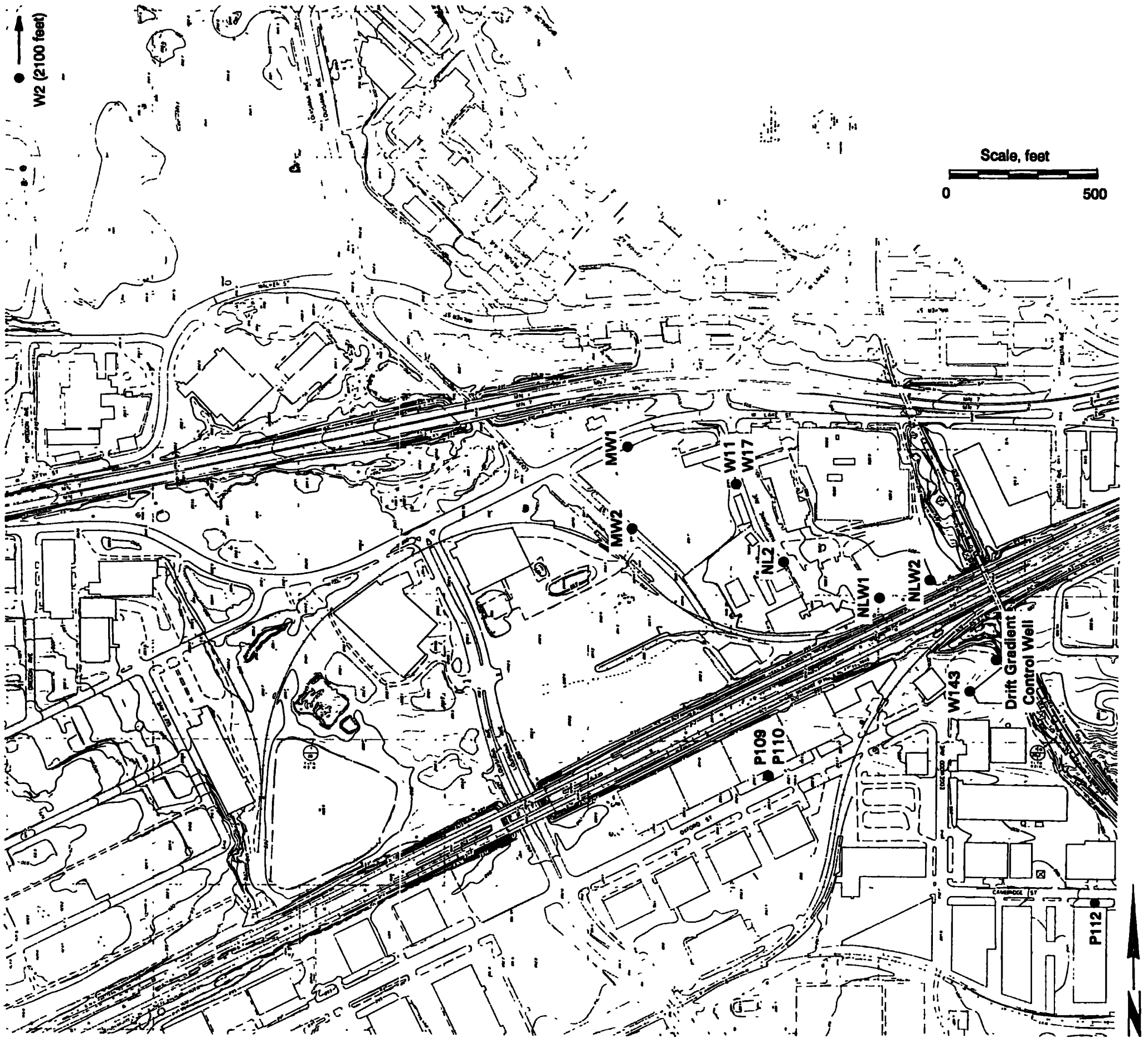

Figure 10. Location of Wells for the Drift Aquifer Gradient Control Well Aquifer Test

levels at the remaining wells. Water levels were recorded for 48 hours prior to the pumping phase of the aquifer test. The Drift-Platteville Aquifer Gradient Control Well was pumped at 90 gallons per minute commencing on October 4, 1987 at 3:40 p.m., and ending on October 8, 1987 at 2:20 p.m. (approximately 95 hours). Higher pumping rates caused too much drawdown in the well. Water levels were then measured for 48 hours to allow for recovery. Data was lost from well W143 at the start of the aquifer test because of an interruption in the transducer circuit.

This aquifer test was different from the first two tests because most of the observation wells did not exhibit water level fluctuations in response to the aquifer test. However, one of the ten observations wells for the third pump test produced data amenable to analysis (W17). The data from this well were analyzed using the Prickett method, with the assumptions presented earlier.

The data and matchpoints used in this analysis are shown in Figure 11. The value calculated for the transmissivity is 5.9e+4 gpd/ft which is within the range of literature values presented for the Drift aquifer and in fair agreement with the results of the Drift source control well pump test above. The value calculated for storativity is 1.06×10^{-2}

The prepumping data for well W17 did not show any appreciable trends and were not corrected for in the analysis. The background well data (W2) did not show any measurable changes over the duration of the third pump test (Figure 12) and were not corrected in the analysis.

The lack of analyzable data from many of the observation wells for the third pump test is in part due to the lower pumping rate for the pump test (90 gpm), the lack of nearby observation wells that were screened at the same depth as the pumping well, and a lower transmissivity for this portion of the Drift aquifer.

SUMMARY

The Drift-Platteville Aquifer Source and Gradient Control Wells have been installed and tested in accordance with approved plans and schedules and Sections 9.1.2 and 9.2.2. of the RAP. Raw data generated during the three aquifer tests have been transmitted to the Minnesota Pollution Control Agency (Schaefer, 1987). In addition, the data are available for inspection and review at ERT, Inc.'s office in Concord, Massachusetts. Well houses have been

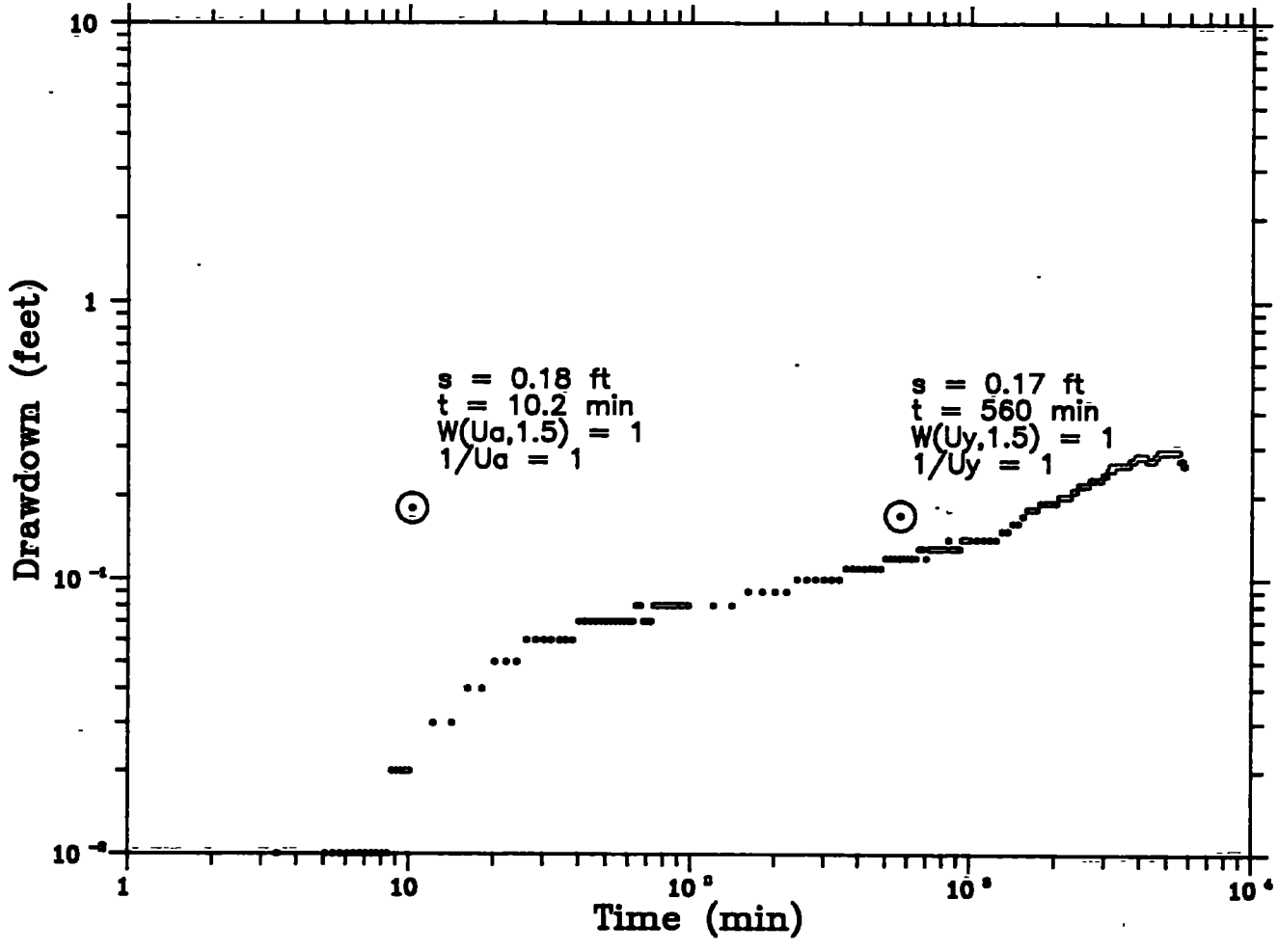

Figure 11. Drift-Platteville Aquifer Gradient Control Well Aquifer Test,

Drawdown Curve for Observation Well W17

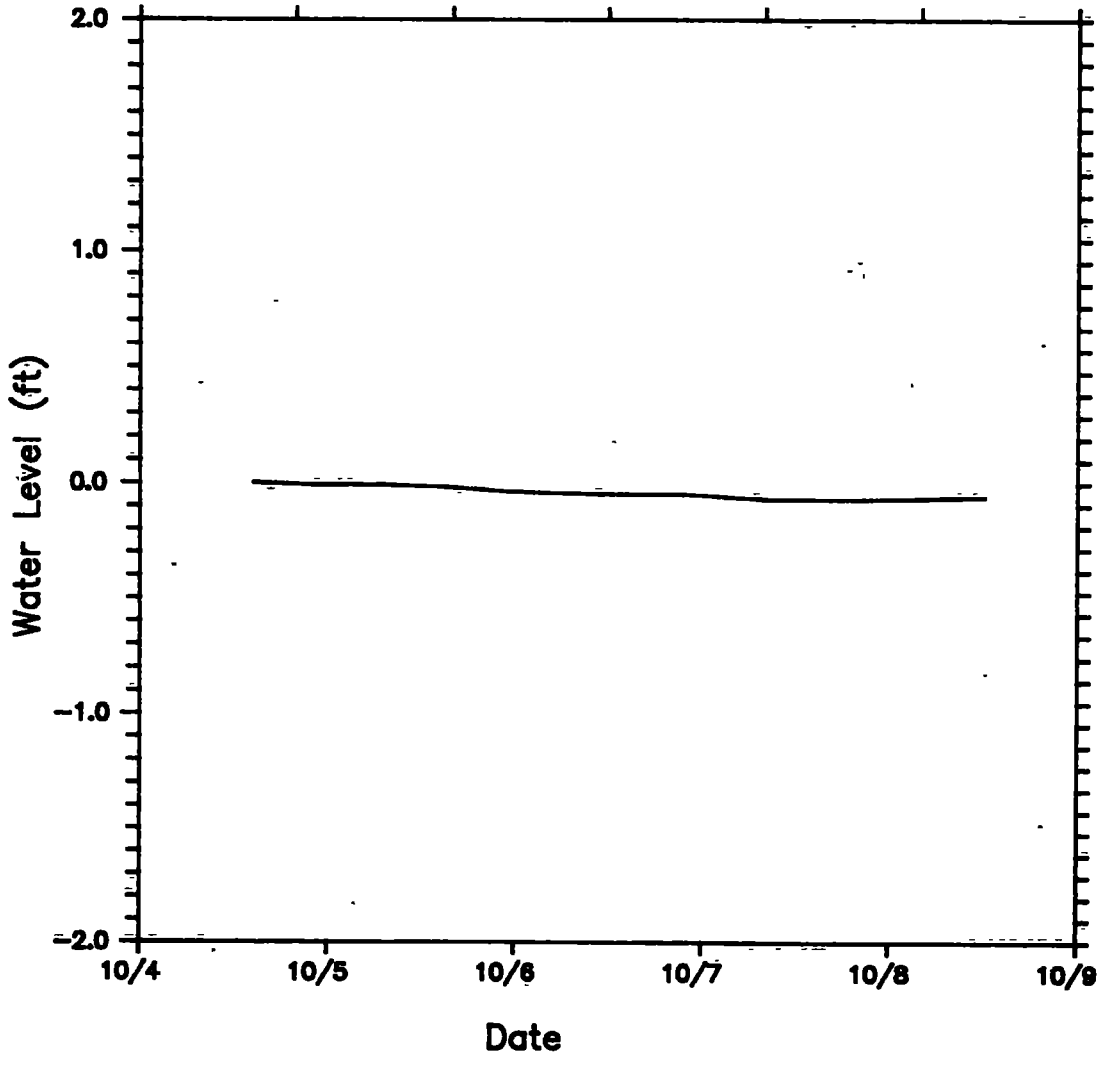

Figure 12. Drift-Platteville Gradient Control Well Aquifer Test, Background Water Level Data - Observation Well W2

constructed and connections with the sanitary sewer system have been made for the discharge from the pumping wells. The three wells are now ready to commence operation in accordance with the requirements of the RAP.

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APPENDIX A

Drift-Platteville Aquifer Source and Gradient Control

Well Water Well Records, Pilot Soil Boring Logs

and

Grain Size Analyses

DRIFT AQUIFER SOURCE CONTROL WELL

- Water Well Record
- Pilot Soil Boring Log
- Grain Size Analyses

LOCATION OF WELL

County Name: Hennepin

WATER WELL RECORD

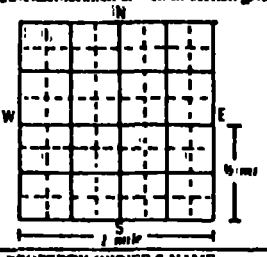
Minnesota Statutes 156A.01 08

MINNESOTA UNIQUE WELL NO. for Water Sample: 434045

Township Name	Township Number	Range Number	Section No	Fraction
St. Louis Park	117 N/S	21 E/W	17	¼ ¼ ¼

Distance and Direction from Road Intersection or Street Address and City of Well Location: NW Quad Lake Street & Louisiana Ave.

Show exact location of well in section grid with "X"



Addition Name:

Block Number:

Lot Number:

Sketch map of well location

2 PROPERTY OWNER'S NAME: City of St. Louis Park

Address: 5005 Minnetonka Blvd.
St. Louis Park, MN 55416
Attn: Jim Grube

3 FORMATION LOG	COLOR	HARDNESS OR FORMATION	FROM	TO
Sand & Topsoil	Black	S	0	2
Sand, T. Gravel & Silt	Brown	VS	2	5
Peat	Black	VS	5	15
Silty Clay - Organic	White	S	15	20
Coarse sand & gravel	Brown	M	20	35
Course Gravel, T. Sand	Multi	M	35	67

Use a second sheet if needed

17 REMARKS, ELEVATION, SOURCE OF DATA, etc.

87-6

Wellhouse finished floor elevation=183.93
Correction to MSL =710.30
Stickup abve floor =1.60
Measuring point elevation =895.83
(top of well seal)

IMPORTANT: FILE WITH DEED -- WELL OWNER COPY

434045

4 WELL DEPTH (completed): 67 ft

Date of Completion: 10/12/87

5 DRILLING METHOD: 1☐ Cable tool 4☐ Reverse 7☐ Driven 10☐ Dug 2☐ Hollow rod 5☐ Air 8☐ Bored 11☐ ____ X 3☐ Rotary 6☐ Jetted 9☐ Power auger

6 DRILLING FLUID: Bentonite

7. USE: 1☐ Domestic 4☒ Monitoring 8☐ Heat Pump 2☐ Irrigation 5☐ Public 9☐ Industry 3☐ Test Well 6☐ Municipal 10☐ Commercial 7☐ Air Conditioning 11☐ ____

8 CASING: 1☒ Black 4☐ Threaded HEIGHT Above/Below Surface 2.5 ft 2☐ Galv. 5☒ Welded Drive Shoe? Yes ☐ No ☒ 3☐ Plastic 6☐

12 in to 40 ft. Weight 49.56 lbs/ft
6 in to 40 ft Weight 18.97 lbs/ft
____ in to ____ ft Weight ____ lbs/ft

HOLE DIAM: 12 in to 40 ft; 12 in to 67 ft; ____ in to ____ ft

9 SCREEN: Make Johnson; Type Wirewound; Dia 6" P.S.; Slot/Gauze No. 70; Length 22' FITTINGS; Set between 40 ft. and 57 ft. 62 67

Or open hole from ____ ft to ____ ft

10 STATIC WATER LEVEL: 11 ft ☐ below ☒ above land surface; Date Measured 8/25/87

11 PUMPING LEVEL (below land surface): 30 ft after 72 hrs pumping 200 g.p.m.
____ ft after ____ hrs pumping ____ g.p.m.

12 HEAD WELL COMPLETION: 1☐ Pitless adapter manufacturer ____ model ____ 2☐ Basement offset 3☒ At least 12" above ground 4☐ Plastic casing protection ____

13. WELL GROUTED? ☒ Yes ☐ No
☒ Neat Cement 2☒ Bentonite 3☐ ____
Grout material 3% from 0 to 35 ft cu yds 0.75

14. NEAREST SOURCES OF POSSIBLE CONTAMINATION: ____ feet ____ direction ____ type
Well disinfected upon completion? ☐ Yes ☒ No

15. PUMP: Date installed 10/12/87 ☐ Not installed
Manufacturer's name Grundfos
Model number SP6-10 HP 2 Volts 200
Length of drop pipe 42 ft. capacity 25 g.p.m.
Material of drop pipe Steel
Type: 1☒ Submersible 3☐ L.S. Turbine 5☐ Reciprocating 2☐ Jet 4☐ Centrifugal 6☐ ____

16 EXISTING WELLS: Unused well on property? ☐ Yes ☒ No
Abandoned ☐ Permanent ☐ Temporary ☐ Not sealed

18. WATER WELL CONTRACTORS CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Bergerson-Caswell Inc. 27058
Licensee Business Name Licensee No.

Address 5115 Industrial Street Maple Plain, MN

Signed E R Kennedy Date 10/12/87
Authorized Representative

Larry Schmidt Date 10/12/87
Name of Driller

6/74 30M
7/78 30M
7/78 30M

STS Consultants Ltd.

Soil Boring Log, Drift Aquifer Source Control Well

PROJECT NAME: Proposed Well House

ARCHITECT-ENGINEER: ERT

SITE LOCATION: St. Louis Park, Minnesota

UNCONFINED COMPRESSIVE STRENGTH TONS-FT² — 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %

10 20 30 40 50

STANDARD PENETRATION BLOWS FT — 10 20 30 40 50

DEPTH in feet / ELEVATION	SAMPLE NO	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
SURFACE ELEVATION						
	1	SS			Silty fine to medium sand, trace coarse sand and roots - dark brown to black - moist - loose - (SM) - (fill)	
	2	SS				
5.0	3	SS			Fine to coarse sand, little gravel, little silt - brown - wet to saturated - medium dense - (SM) - (fill)	
	3A	SS				
	4	SS			Fine fibrous peat - black - (Pt)	
10.0	5	SS			Amorphous peat - black - (Pt)	
15.0	6	SS				
	6A	SS			Organic silty clay, trace fibers - white - firm - (OH)	
20.0	7	SS				
	7A	SS			Fine to coarse sand, trace gravel and silt - gray - saturated - medium dense - (SP) Note: Cresote like odor in sample 7 and 8.	
25.0	8	SS				
					End of boring at 26.0 ft. Hollow stem auger to full depth.	

⊗5 ⊗12 ⊗4 ⊗5 6⊗5* ⊗4 ⊗10 ⊗10 O* - calibrated penetrometer

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 2.3 ft. WS	WS OR WD	BORING STARTED 9/29/86	STS OFFICE Minnesota		
WL	BCR ACR	BORING COMPLETED 9/29/86	DRAWN BY KC	SHEET NO. 1 OF 1	
WL 1.5 ft. AB		RIG CME-45 FOREMAN GD	APP'D BY WBT	STS JOB NO. 94026	

BL: 1-983

STS Consultants Ltd.

PROJECT NAME	ARCHITECT—ENGINEER
Proposed Well House	ERT

SITE LOCATION: St. Louis Park, Minnesota

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE / RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH TSF/FT²
				SURFACE ELEVATION +100 feet		
				Hollow stem augered to 17.5 feet - see log of boring #2 for soil conditions above 17.5 feet		
98.5	1	SS		Organic silty clay, little sand - dark brown - firm - (OH)		9
	2	SS		Clayey silt - gray - soft - (ML - CL)		10
	2A	SS				
	3	SS		Silty sand - gray - saturated - medium dense - (SM)		5/6"
85.5						8
	4	SS		Fine to coarse sand, little gravel, trace silt - gray - saturated - loose - (SW - SP)		10
	5	SS		Note: 31.0 feet driller notes hole caving due to gravel		6
80.5	6	SS				11
	7	SS		Fine to medium sand, trace coarse sand, trace gravel, trace silt - brown - saturated - medium dense - (SP)		16
	8	SS				30
75.5	9	SS		Silty sand, trace gravel - brown - saturated - medium dense - (SM)		27
	10	SS				14/6"
	10A	SS		Sandy gravel, trace silt - gray - saturated - medium dense - (GP)		8/6"
70.5	11	SS				18
	12	SS		Fine to coarse sand, trace gravel, trace silt - gray - saturated - medium dense - (SP) - (SW)		8
	13	SS				10
	14	SS				27
65.5	15	SS				29
	16	SS				15
	17	SS				17
60.5	18	SS				23
	19	SS				22
	20	SS				19
55.5	21	SS				14
	22	SS				8/6"
	23	SS		Fine to medium sand, little silt, trace gravel - brown - medium dense - (SM)		17 / 22/6"
50.5	24	SS		Sandy gravel, trace silt - gray - saturated - medium dense - (GP)		24
	25	SS				21
	26	SS		Fine to coarse sand, trace to little gravel, trace silt - gray - saturated - medium dense - (SW) - (SP)		19
45.5	27	SS				10
	28	SS		Sandy gravel, trace silt - gray - saturated - medium dense - limestone gravel - (GP) - (clay seams)		20 / 55/6"
	29	SS				
40.5	29A	RS		Platteville limestone		100/3"

End of boring at 66.8 ft.
Hollow stem augered to 17.5 ft. Drilled with 2 15/16" rockbit and bentonite drilling fluid 17.5 ft. to 32.5 ft. Caving gravel 31 feet. Set hollow stem to 32.5 ft. Drilled with 2 15/16" rockbit and bentonite drilling fluid from 32.5-66.0 ft. Grouted hole with neat cement grout.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL	WS OR WD	BORING STARTED	10/24/86	STS OFFICE	Minnesota
WL	BCR . ACR	BORING COMPLETED	10/24/86	DRAWN BY AH	SHEET NO. 1 OF 1
WL		RIG CME-75 FOREMAN GD		APP'D BY BCJ	STS JOB NO. 94026

Sand Size Analysis Results, Drift Aquifer Source Control Well

SAND ANALYSIS REPORT

DRILLER STS CONSULTANTS, LTD.

ENGINEER ERT
ST. LOUIS PARK, MINNESOTA 55416

ANALYSIS BY ALBERT J. SMITH
DATE 19 NOVEMBER, 1986

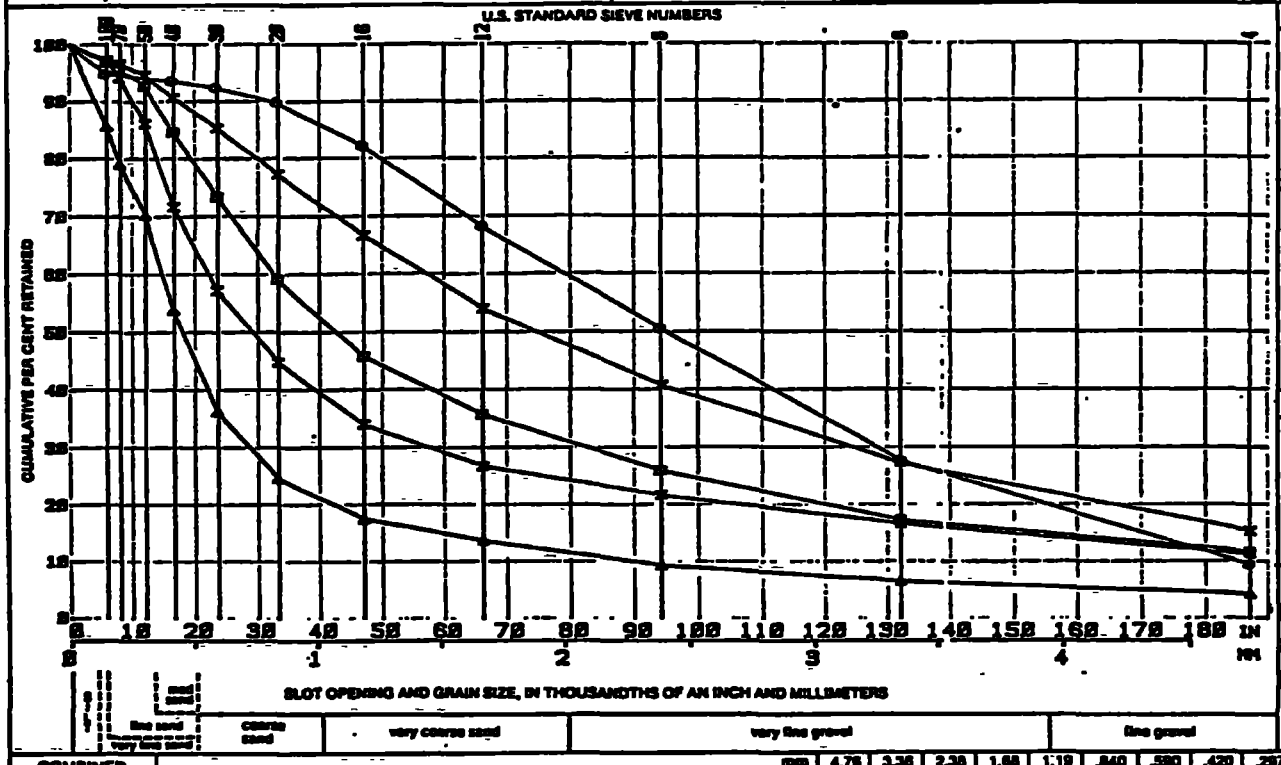
JOB NAME

LOCATION

JOHNSON I.D. NUMBER 86321E1
SAMPLE SENT IN BY ERT

Johnson Division
P.O. Box 64118 St. Paul, Minn. 55164
Tel. 612-636-3900
800-328-8110
Telex 297451

PAGE ____ OF ____



TEST HOLE DATA

DIAMETER

DEPTH 67.5 FEET

DRILLING METHOD

DRILLING FLUID

GEOPHYSICAL LOGS

STATIC WATER LEVEL
10'

COMMENTS

Centering guides would be required to center the 6" pipe size screen within the 10" diam. borehole.

(57-62 ft) should be cased off if the recommended gravel pack is utilized.

WELL DATA

CASING DIAMETER

DESIRED YIELD

WELL APPLICATION
Gradient Control

DESIGN RECOMMENDATIONS

Utilize a gravel pack material similar in gradation to the #20 gravel from American Materials Corp, Eau Claire, Wisc, in conjunction with a #70 slot screen

SCREEN RECOMMENDATIONS

DIAMETER 6 P.S.

SLOT	LENGTH	SETTING
.070	17	40-57
.070	5	62-67

COMBINED SAMPLE DEPTHS	PHYSICAL SAMPLE DESCRIPTION	CUMULATIVE % RETAINED	mm	4.76	3.36	2.38	1.68	1.19	.840	.590	.420	.297	.210	.149	.074	.053	TOTAL WT.
			Inches	.187	.123	.094	.066	.047	.033	.023	.016	.012	.008	.006	.003	.002	
			U.S. Sieve #	4	6	8	12	18	20	30	40	50	70	100	200	270	
28 / 24.5 FT.	O SAMPLES #S-2 & #S-3			9.5	27.8	58.6	68.4	82.3	88.9	92.4	93.7			94.9			158.8
25 / 34 FT.	□ SAMPLES #S-4, S-5, S-6 & S-8			11.7	17.3	28.8	35.7	45.8	59.2	73.5	84.7	92.9	95.9	98.9			198.8
34 / 42 FT.	Δ SAMPLES #S-9 & S-10			4.4	6.6	9.3	13.7	17.6	24.7	38.3	53.8	78.3	79.1	85.7			182.8
38 / 41 FT.	X SAMPLES #S-11 & S-12			11.2	16.7	21.7	26.8	34.1	44.9	57.2	71.7	88.2	94.2	97.1			278.8
41.5-47.5 FT.	X SAMPLES #S-13, S-14, S-15 & S-16			15.3	27.3	48.7	54.8	68.7	77.3	85.3	98.7	94.7	98.7	97.3			288.8

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT, WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF JOHNSON WELL SCREENS.

DRILLER

ENGINEER

ANALYSIS BY

DATE 13 NOVEMBER, 1986

JOB NAME

LOCATION

JOHNSON I.D NUMBER 86921E2

SAMPLE SENT IN BY ERT

SAND ANALYSIS REPORT

Johnson Division
P.O. Box 64118 St. Paul, Minn. 55164
Tel. 612-636-3900
800-328-9110
Telex 297451

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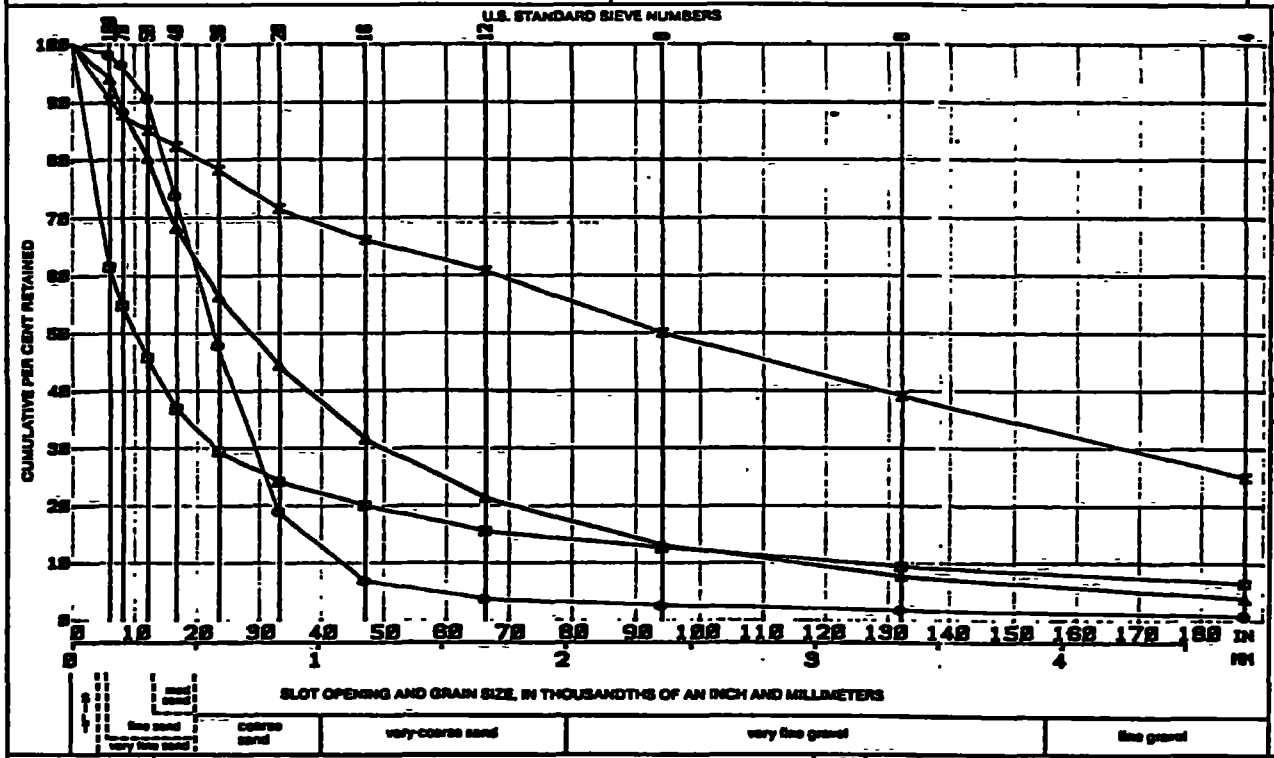


TEST HOLE DATA

DIAMETER

DEPTH

DRILLING METHOD

DRILLING FLUID

GEOPHYSICAL LOGS

STATIC WATER LEVEL

COMMENTS

WELL DATA

CASING DIAMETER

DESIRED YIELD

WELL APPLICATION

DESIGN RECOMMENDATIONS

SCREEN RECOMMENDATIONS

DIAMETER

SLOT	LENGTH	SETTING

COMBINED SAMPLE DEPTHS	PHYSICAL SAMPLE DESCRIPTION	mm	4.76	3.36	2.38	1.68	1.19	.840	.590	.420	.297	.210	.149	.074	.053	TOTAL WT.
		Inches	.187	.123	.094	.066	.047	.033	.023	.016	.012	.008	.006	.003	.002	
		U.S. Sieve #	4	6	8	12	18	20	30	40	50	70	100	200	270	
47 – 57 FT.	○ SAMPLES •S-18, S-17, S-19, S-28, S-21, S-22	CUMULATIVE % RETAINED	8.9	1.7	2.6	3.8	6.9	19.1	48.8	74.8	92.8	98.5	98.3			348.8
57 – 68 FT.	□ SAMPLES •S-23 & S-24		6.6	9.4	12.7	15.6	28.1	24.2	29.5	36.9	45.9	54.9	61.5			244.8
68 – 68 FT.	△ SAMPLES •S-25, S-26, S-27 & S-28		3.8	7.7	13.2	21.4	31.6	44.4	58.4	68.4	88.3	88.9	94.8			234.8
68 – 67.5 FT.	⊠ SAMPLES •S-29		25.8	39.2	58.8	68.8	68.2	71.6	78.4	92.4	95.1	97.8	98.5			148.8

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT, WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF JOHNSON WELL SCREENS.

PLATTEVILLE AQUIFER SOURCE CONTROL WELL

- **Water Well Record**

1 LOCATION OF WELL

County Name: Hennepin

WATER WELL RECORD

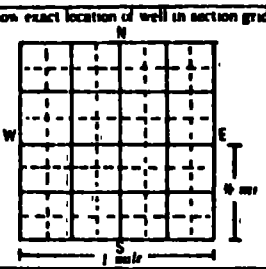
Minnesota Statutes 156A.01 .08

MINNESOTA UNIQUE WELL NO. for Water Sample: 434044

Township Name	Township Number	Range Number	Section No	Fraction
St. Louis Park	117 (N)	21 (E)	17	¼ ¼ ¼

Distance and Direction from Road Intersection or Street Address and City of Well Location: NW Quad Lake Street & Louisiana Ave.

Show exact location of well in section grid with "X" — Sketch map of well location



Addition Name:

Block Number:

Lot Number:

2 PROPERTY OWNER'S NAME: City of St. Louis Park

Address: 5005 Minnetonka Blvd., St. Louis Park, MN 55416

Attn: Jim Grube

3 FORMATION LOG	COLOR	HARDNESS OF FORMATION	FROM	TO
Sand & Top Soil	Black	S	0	2
Sand, T.Gravel & Silt	Brown	VS	2	5
Peat	Black	VS	5	15
Silty Clay - Organic	White	S	15	20
Coarse Sand & Gravel	Brown	M	20	35
Coarse Gravel	Multi	M	35	67
Platteville Limestone	Orange-Grn	VH	67	84

Use a second sheet, if needed

17 REMARKS, ELEVATION, SOURCE OF DATA, etc.

87-6

Wellhouse finished floor elevation=183.93
Corection to MSL =710.30
Stick up above floor =1.56
Measuring point elevation =895.79
(top of well seal)

IMPORTANT: FILE WITH DFED — WELL OWNER COPY

434044

4 WELL DEPTH (completed): 84 ft

Date of Completion: 10/12/87

5 DRILLING METHOD: 1 Cable tool; 2 Hollow rod; X 3 Rotary; 4 Reverse; 5 Air; 6 Jetted; 7 Driven; 8 Bored; 9 Power auger; 10 Dug; 11 ____

6. DRILLING FLUID: Bentonite

7 USE: 1 Domestic; 2 Irrigation; 3 Test Well; X 4 Monitoring; 5 Public; 6 Municipal; 7 Air Conditioning; 8 Heat Pump; 9 Industry; 10 Commercial; 11 ____

8 CASING: X 1 Black; 2 Galv.; 3 Plastic; 4 Threaded; X 5 Welded; 6 ____

HEIGHT (Above/Below) Surface 2.5 ft

Drive Shoe? Yes ____ No X

			HOLE DIAM.
12 in to 20 ft.	Weight 49.56 lbs/ft		12 in to 20 ft
6 in to 67 ft.	Weight 18.97 lbs./ft.		12 in. to 67 ft
____ in to ____ ft	Weight ____ lbs./ft		____ in. to ____ ft

9 SCREEN: Make ____ Or open hole from 67 ft to 84 ft

Type ____ Dia ____

Slot/Gauze ____ Length ____

Set between ____ ft. and ____ ft. FITTINGS

10 STATIC WATER LEVEL: 11 ft. ☐ below X above land surface — Date Measured 8/25/87

11 PUMPING LEVEL (below land surface)

40 ft after 48 hrs pumping 50 g p m

____ ft after ____ hrs. pumping ____ g p m

12 HEAD WELL COMPLETION

1 Pitless adapter manufacturer ____ model ____

2 Basement offset X 3 At least 12" above ground

4 Plastic casing protection ____

13 WELL GROUTED? X Yes ☐ No

X 1 Neat Cement X 2 Bentonite 3 ____

Grout material 3% from 0 to 67 ft cu. yds 1.0

14 NEAREST SOURCES OF POSSIBLE CONTAMINATION

____ feet ____ direction ____ type

Well disinfected upon completion? ☐ Yes X No

15 PUMP

Date installed 10/12/87 ☐ Not installed

Manufacturer's name Grundfos

Model number SP6-10 HP 2 Volts 200

Length of drop pipe 42 ft. capacity 25 g.p.m.

Material of drop pipe Steel

Type X 1 Submersible 3 L.S. Turbine 5 Reciprocating

2 Jet 4 Centrifugal 6 ____

16 EXISTING WELLS

Unused well on property? ☐ Yes X No

Abandoned ☐ Permanent ☐ Temporary ☐ Not sealed

18 WATER WELL CONTRACTORS CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Bergerson-Caswell Inc. — License Business Name — 27058 License No

Address 5115 Industrial Street Maple Plain, MN

Signed E R Hammond — Authorized Representative — Date 10/12/87

Larry Schmidt — Name of Driller — Date 10/12/87

5/74 30M
7/78 30M
7/78 30M

DRIFT AQUIFER GRADIENT CONTROL WELL

- Water Well Record
- Pilot Soil Boring Log
- Grain Size Analyses

LOCATION OF WELL

County Name: Hennepin

WATER WELL RECORD

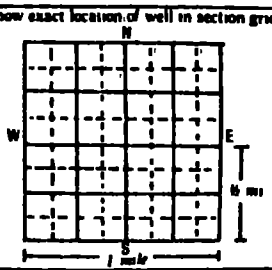
Minnesota Statutes 156A.01 .08

MINNESOTA UNIQUE WELL NO. for Water Sample: 434043

Township Name	Township Number	Range Number	Section No.	Fraction
St. Louis Park	117 N/S	21 E/W	17	¼ ¼ ¼

Distance and Direction from Road Intersection or Street Address and City of Well Location: 6425 Oxford Street - In Front on City Row

Show exact location of well in section grid with "X." Sketch map of well location



Addition Name:

Block Number:

Lot Number:

2 PROPERTY OWNER'S NAME: City of St. Louis Park

Address: 5005 Minnetonka Blvd.
St. Louis Park, MN 55416
Attn: Jim Grube

3 FORMATION LOG	COLOR	HARDNESS OF FORMATION	FROM	TO
Sand	Brown	S	0	15
Clayey Sand	Brown	M	15	25
Silty F. Sand; T. Gravel	Brown	M	25	55
Med. Gravel; T. Sand	Multi	H	55	78

Use a second sheet, if needed

17 REMARKS, ELEVATION, SOURCE OF DATA, etc

87-6

Wellhouse finished floor elevation =196.35
Correction to MSL =710.30
Stickup above floor =1.53
Measuring point elevation =908.18
(top of well seal)

IMPORTANT:
FILE WITH DEED—WELL OWNER COPY

434043

4 WELL DEPTH (completed): 78 ft. Date of Completion: 10/12/87

5 DRILLING METHOD: [X] 3 Rotary

6 DRILLING FLUID: Bentonite

7 USE: [X] 4 Monitoring

8 CASING: [X] 1 Black [X] 5 Welded

HEIGHT Above/Below Surface: 2.5 ft

Drive Shoe? Yes ___ No X

			HOLE DIAM
12 in to 20 ft.	Weight 49.56 lbs/ft		12 in to 20 ft
6 in. to 53 ft.	Weight 18.97 lbs/ft		12 in to 78 ft
___ in to ___ ft	Weight ___ lbs/ft		___ in. to ___ ft

9 SCREEN: Make Johnson; Type Wire Wound; Dia 6" P.S.; Slot/Gauge No. 40; Length 25' FITTINGS; Set between 53 ft and 78 ft

Or open hole from ___ ft to ___ ft

10 STATIC WATER LEVEL: 25 ft [ ] below [X] above land surface; Date Measured 9/10/87

11 PUMPING LEVEL (below land surface): 42 ft. after 72 hrs pumping 90 g.p.m.

___ ft after ___ hrs. pumping ___ g.p.m.

12. HEAD WELL COMPLETION: [X] 3 At least 12" above ground

13. WELL GROUTED? [X] Yes [ ] No

[X] 1 Neat Cement [X] 2 Bentonite

Grout material 3% from 0 to 48 ft cu yds. 0.5

14 NEAREST SOURCES OF POSSIBLE CONTAMINATION: ___ feet ___ direction ___ type

Well disinfected upon completion? [ ] Yes [X] No

15 PUMP: Date installed 10/12/87 [ ] Not installed

Manufacturer's name Grundfos

Model number SP16-5 HP 5 Volts 200

Length of drop pipe 42 ft. capacity 50 g.p.m.

Material of drop pipe Steel

Type: [X] 1 Submersible 3 L.S. Turbine 5 Reciprocating 2 Jet 4 Centrifugal 6 ___

16. EXISTING WELLS

Unused well on property? [ ] Yes [X] No

Abandoned [ ] Permanent [ ] Temporary [ ] Not sealed

18 WATER WELL CONTRACTORS CERTIFICATION

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Bergerson-Caswell Inc. 27058
Licensee Business Name License No.

Address 5115 Industrial Street, Maple Plain, MN

Signed E R Holman Date 10/12/87
Authorized Representative

Glenn Holman Date 10/12/87
Name of Driller

MN 01705.09 (Rev. 10/85) 9/74 3DM 7/76 3DM 7/78 3DM

Soil Boring Log, Drift Aquifer Gradient Control Well

STS Consultants Ltd.

PROJECT NAME	ARCHITECT-ENGINEER
Proposed Well House	ERT

SITE LOCATION: St. Louis Park, Minnesota

DEPTH in feet / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % / STANDARD PENETRATION BLOWS/FT
					SURFACE ELEVATION		
	1	SS			Fine to medium sand, little silt, trace gravel - brown - moist - medium dense - (SM)		50/1"
	2	SS					35
5.0	3	SS			Fine to medium sand, trace coarse sand and gravel, trace silt - brown - dense to medium dense - (SP)		20
	4	SS			Fine sand, trace silt and medium sand - brown - moist - medium dense - (SP)		15
10.0							
11.0	5	SS					14
					End of boring at 11.0 ft. Power augered to full depth.		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL Dry WS OR WD	BORING STARTED 9/29/86	STS OFFICE Minnesota	
WL BCR ACR	BORING COMPLETED 9/29/86	DRAWN BY KC	SHEET NO. 1 OF 1
WL Dry AB	RIG CME-45 FOREMAN GD	APP'D BY WBT	STS JOB NO. 94026

STS Consultants Ltd.

PROJECT NAME	ARCHITECT—ENGINEER
Proposed Wall House	ERT, Inc.

SITE LOCATION: St. Louis Park, Minnesota

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) · PLASTIC LIMIT % · WATER CONTENT % · LIQUID LIMIT % (10 20 30 40 50) · STANDARD PENETRATION BLOWS/FT (10 20 30 40 50)
					SURFACE ELEVATION		
5.0					Hollow stem augered to 14.0 feet - see log of boring #1 for soil conditions above 14.0 feet		
10.0							
15.0	1	SS			Fine to medium sand, trace coarse sand and silt - brown - moist - medium dense - (SP)		22
	2	SS			Clayey sand, some silt, trace gravel - brown - moist - medium dense - (SC)		24
20.0	3	SS			Fine sand, trace silt - brown - moist - medium dense (estimated) cobble at 19.75 feet - (SP)		129
	4	SS			Clayey silt, trace interbedded sand seams - grayish brown - wet to saturated - medium dense (ML - CL)		46
25.0	5	SS			Silty fine to medium sand, trace gravel and coarse sand - brown - saturated - medium dense to very dense - (SM)		52
	6	SS					17
30.0	7	SS					50
	8	SS					38
35.0	9	SS					47
	10	SS					101
40.0	11	SS					42
	12	SS					88
45.0	13	SS					74
	14	SS					57
50.0	15	SS					59
	16	SS					46
55.0					Continued on next page		

*THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES, IN SITU, THE TRANSITION MAY BE GRADUAL.

STS JOB NO. 94026-B

STS Consultants Ltd.

PROJECT NAME	ARCHITECT—ENGINEER
Proposed Mall House	ERT, Inc.

SITE LOCATION: St. Louis Park, Minnesota

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH (tons/ft²) 1 2 3 4 5	PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % 10 20 30 40 50	STANDARD PENETRATION (blows/ft.) 10 20 30 40 50	
					SURFACE ELEVATION					
					Continued from page 1					
55.0										
	17	SS								100/4"
	18	SS			Medium to coarse sand, trace silt, trace gravel - brownish gray - saturated - extremely dense - (SP - SM)					128/6"
60.0	19	SS								239
	20	SS			Faint chemical odor in sample #20					200/6"
65.0	21	SS			Fine to medium sand, trace silt - gray - saturated - extremely dense - (SP - SM)					134/6"
	22	SS								157/6"
70.0	23	SS								138/6"
	24	SS			Fine sand, trace medium sand and silt - gray - saturated - extremely dense - (SP - SM)					161/6"
75.0	25	SS								164/6"
	26	SS			Silty sand, trace gravel - brown - wet - extremely dense - (SM)					300/5"
80.0					Platteville limestone - inferred					
					End of boring at 80.0 ft. Hollow stem augered to 26.5 ft. Drilled with 2 15/16" rockbit and bentonite drilling fluid from 26.5 - 80.0 ft. Grouted hole with 50 gallons of neat cement grout.					

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 25.5 ft. WS	WS OR WD	BORING STARTED	3/25/87	STS OFFICE	Minnesota
WL	BCR ACR	BORING COMPLETED	3/26/87	DRAWN BY	KC
WL		RIG CME-75 FOREMAN	GD	APP'D BY	WBT

SHEET NO. 2 OF 2

STS JOB NO. 94026-B

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TELEX 29-7451
SEND SAMPLES TO: 1950 OLD HWY 8, NEW BRIGHTON, MN 55112

SAND ANALYSIS
BY:

Job Name Reilly Tar & Chemical Corporation Date 31 March, 1987

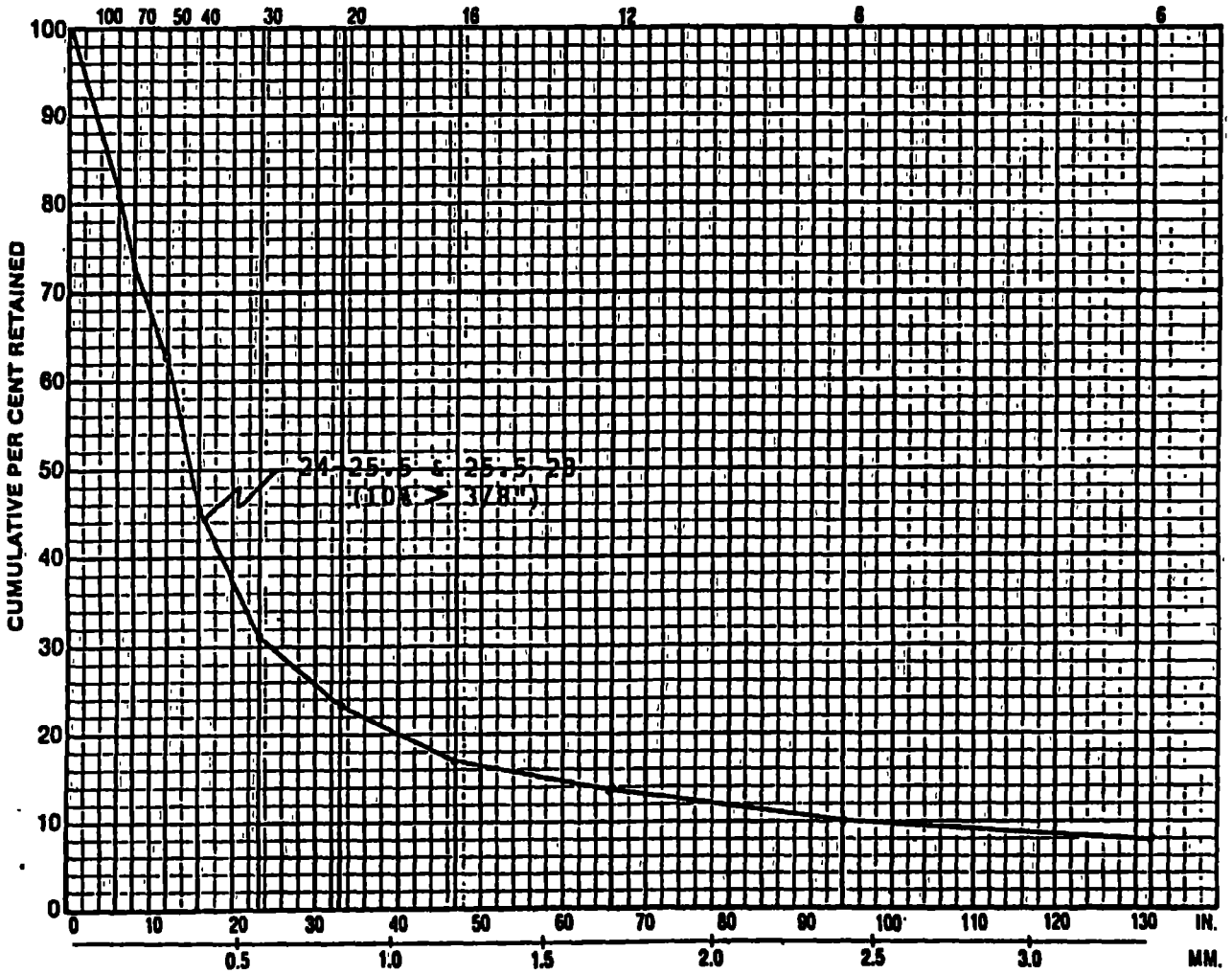
City St. Louis Park State Minn Zip

Driller STS Consultants, Ltd. Phone

Engineer ERT, St. Louis Park, MN SWL=20 ft. Phone

Remarks Did not test 21.5-23, sandy clay (Gradient control well)

U.S. STANDARD SIEVE NUMBERS



SLOT OPENING AND GRAIN SIZE IN THOUSANDTHS OF AN INCH AND MM.

U.S. SIEVE NO.	SLOT OPENING IN.	SLOT OPENING MM	SAMPLE DEPTHS 24/25			
6	.132	3.36	8			
8	.094	2.36	10			
12	.066	1.68	14			
16	.047	1.19	17			
20	.033	0.84	23			
30	.023	0.60	31			
40	.016	0.42	45			
50	.012	0.30	63			
70	.008	0.21	73			
100	.006	0.15	81			

Comments Utilize a gravel pack material similar in gradation to the #30 gravel from American Materials Corp., Eau Claire, Wisc., in conjunction w/a #40 slot screen.

SCREEN RECOMMENDATIONS: DIAM.

SLOT	SETTING	LENGTH
.040	53-78 ft.	25 ft.

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT, WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF ANY WELL.

Sand Size Analysis Results, Drift Aquifer Gradient Control Well

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SEND SAMPLES TO: 1950 OLD HWY 8, NEW BRIGHTON, MN 55112

SAND ANALYSIS
BY:

Job Name _____ Date 31 March, 1987

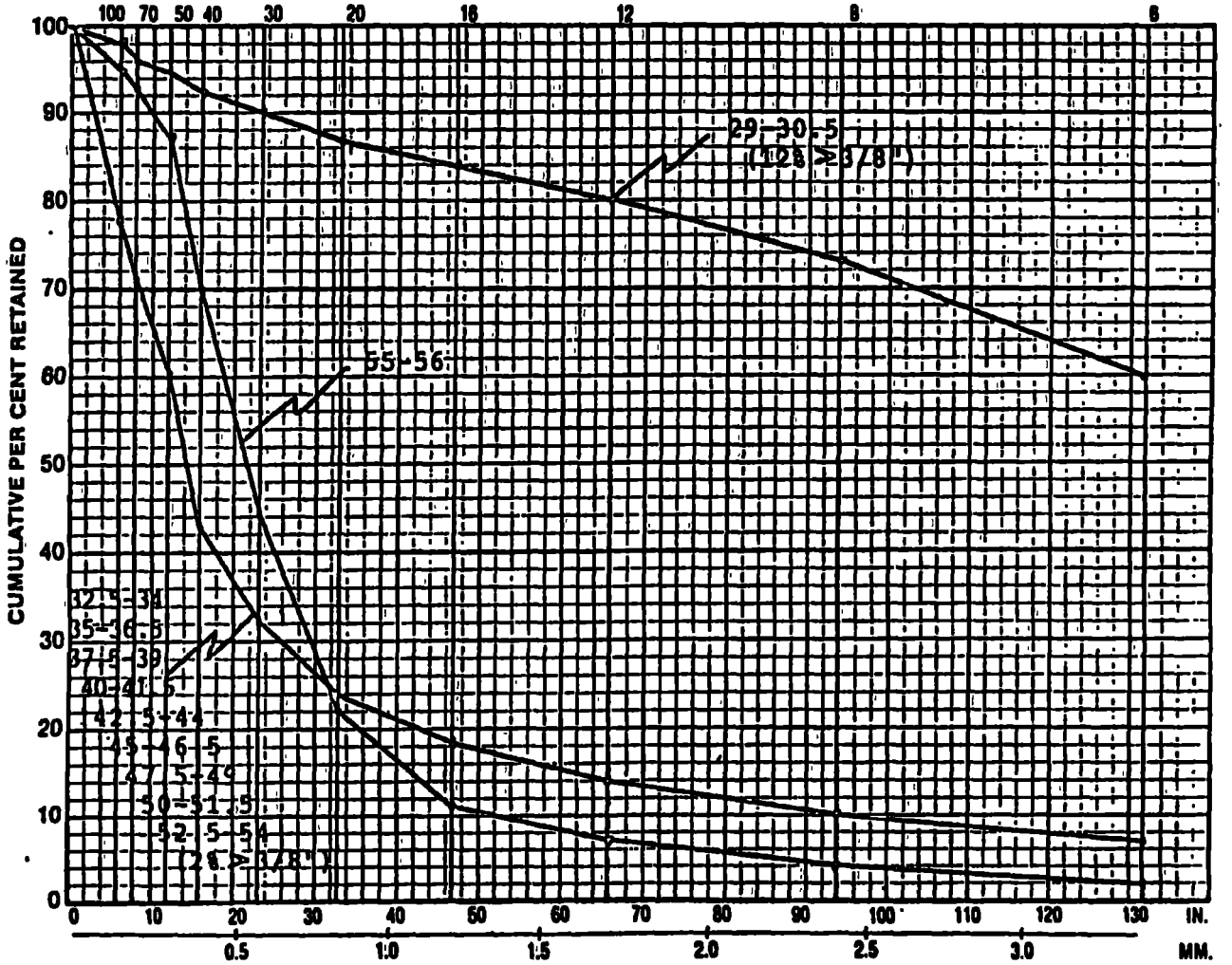
City _____ State _____ Zip _____

Driller _____ Phone _____

Engineer _____ Phone _____

Remarks _____

U.S. STANDARD SIEVE NUMBERS



SLOT OPENING AND GRAIN SIZE IN THOUSANDTHS OF AN INCH AND MM.

U.S. SIEVE NO.	SLOT OPENING IN.	SLOT OPENING MM	SAMPLE DEPTHS 29-30.5	32.5/54	55-56	
6	.132	3.36	60	7	2	
8	.094	2.38	73	10	4	
12	.066	1.68	80	14	7	
16	.047	1.19	84	18	11	
20	.033	0.84	87	24	22	
30	.023	0.60	90	32	44	
40	.016	0.42	92	43	70	
50	.012	0.30	95	60	87	
70	.008	0.21	96	71	93	
100	.006	0.15	98	78	95	

Comments _____

SCREEN RECOMMENDATIONS: DIAM. _____

SLOT	SETTING	LENGTH

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BY:

Job Name _____ Date 31 March, 1987

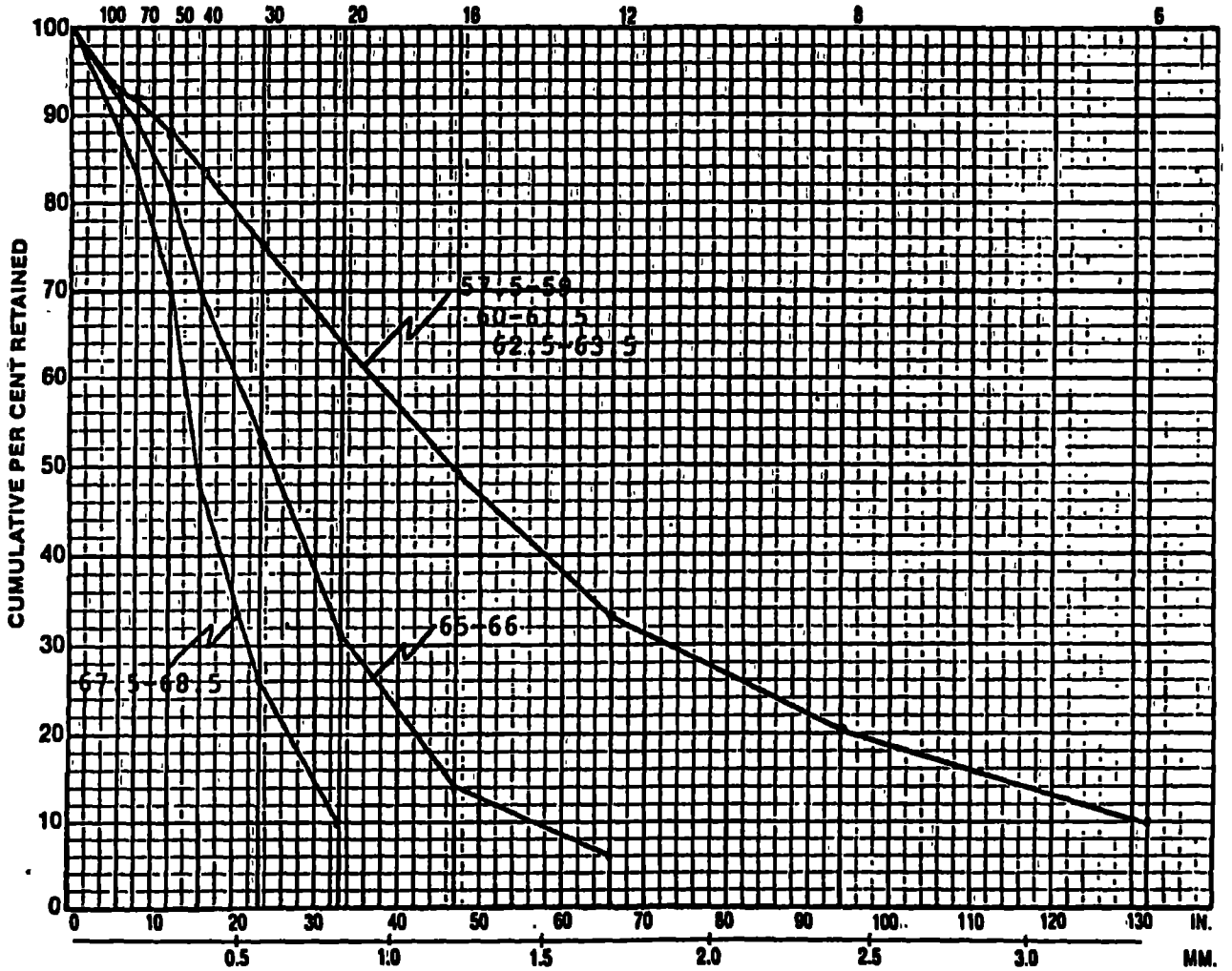
City _____ State _____ Zip _____

Driller _____ Phone _____

Engineer _____ Phone _____

Remarks _____

U.S. STANDARD SIEVE NUMBERS



SLOT OPENING AND GRAIN SIZE IN THOUSANDTHS OF AN INCH AND MM.

U.S. SIEVE NO.	SLOT OPENING IN.	SLOT OPENING MM	SAMPLE DEPTHS 57.5-58.5	65-66	67.5-68.5	
6	.132	3.36	10			
8	.094	2.38	20			
12	.066	1.68	33	6		
16	.047	1.19	49	14		
20	.033	0.84	64	31	10	
30	.023	0.60	75	53	26	
40	.016	0.42	83	70	48	
50	.012	0.30	88	82	71	
70	.008	0.21	92	89	83	
100	.006	0.15	93	92	88	

Comments _____

SCREEN RECOMMENDATIONS: DIAM. _____

SLOT	SETTING	LENGTH

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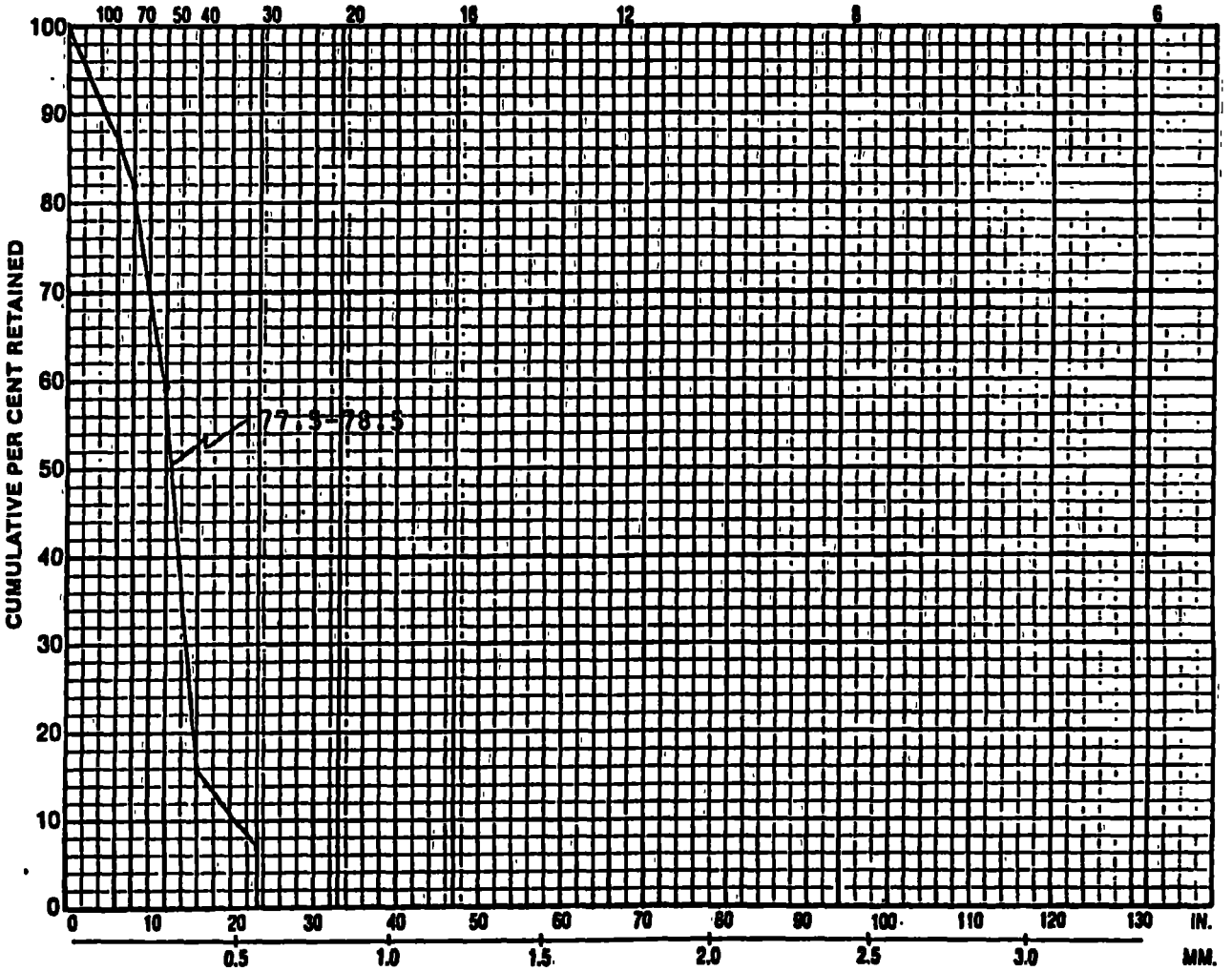

SLOT OPENING AND GRAIN SIZE IN THOUSANDTHS OF AN INCH AND MM.

U.S. SIEVE NO.	SLOT OPENING IN.	SLOT OPENING MM	SAMPLE DEPTHS 77.5-78.5			
6	.132	3.36				
8	.094	2.38				
12	.066	1.68				
16	.047	1.19				
20	.033	0.84				
30	.023	0.60	7			
40	.016	0.42	16			
50	.012	0.30	59			
70	.008	0.21	82			
100	.006	0.15	87			

Comments _____

SCREEN RECOMMENDATIONS: DIAM. _____

SLOT	SETTING	LENGTH

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